EFFECTS OF ALCOHOL IN SOCIAL CONTEXT: A MULTIVARIATE, SEQUENTIAL ANALYSIS

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BA, University of Wyoming, 1999

Submitted to the Graduate Faculty of

Psychology in partial fulfillment

of the requirements for the degree of

Master of Science

University of Pittsburgh

2004

UNIVERSITY OF PITTSBURGH

FACULTY OF ARTS AND SCIENCES

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Social factors heavily influence the initiation and maintenance of alcohol use and misuse, but researchers seldom study the acute effects of alcohol in social context. This is due in part to difficulty capturing the effects of alcohol on social behavior in a controlled, laboratory setting. The primary aim of the present research was to use systematic observation techniques to measure the effects of alcohol on behavioral responses during an initial group interaction. Fifty-four male social drinkers were assembled into three-person groups, and all members of each group were administered either a moderate dose of alcohol (0.82 g/kg) or an alcohol placebo to be consumed over 30 minutes. This "free drink" period was audio and video recorded, and the duration and sequence of selected smiling and speech behaviors were systematically coded from the videotape. Participants then completed self-report measures of affect and perceived social bonding. Results indicate that although alcohol consumption did not increase the overall *amount* of participants' behavioral responses, consumption did increase group-level *coordination* of smiling and speech behaviors over time. Following the free drink, participants did not report improved mood, and self-reported social bonding did not differ between groups. Potential applications of this laboratory–based paradigm for measurement of the acute effects of alcohol are discussed.

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1.0 INTRODUCTION

Alcohol researchers have long been interested in determining why some people value the effects of alcohol more than others, and subsequently drink to excess. This has proven difficult, in part, because the subjective effects of alcohol are determined by multiple interacting factors (Marlatt, Baer, Donovan, & Kivlahan, 1988). To better account for the relative contributions of multiple factors, it would be useful to examine the effects of alcohol consumption in social context. The social context of drinking influences whether people choose to drink, how much they consume, and whether they consider the effects reinforcing (Hussong, 2003; Maisto, Carey, & Bradizzo, 1999). Moreover, there is evidence that social factors play an important role in the development and treatment of alcohol misuse, and enhance vulnerability to craving and relapse (Griffiths, Bigelow, & Liebson, 1978; Read, Kahler, & Stevenson, 2001; Tucker, Vuchinich, & Pukish, 1995).

For the purpose of the current research, <u>social context</u> was defined as the immediate social environment that surrounds alcohol consumption. When they choose to drink, non-problem drinkers most often consume alcohol in social context (e.g., Bachman, Johnston, O'Malley, & Bare, 1985; Kahler, Read, Wood, & Palfai, 2003). Alcohol is commonly valued for both its enhancing effects on interpersonal experience, and its dampening effects on social anxiety (Cooper, Lynne, Frone, Russell, & Mudar, 1995; Greeley & Oei, 1999). Accordingly, prominent models of alcohol use and misuse assume that people are often motivated to drink for social reasons (Marlatt & Gordon, 1985; Monti, Abrams, Kadden, & Cooney, 1988; Rohrbaugh, Shoham, Spungen & Steinglass, 1995). Yet researchers have seldom attempted to examine the acute effects of alcohol on social behavior (e.g., Doty & de Wit, 1995; Sher, 1985), and the influence of alcohol on the encoding and interpretation of higher-order, social information remains unclear (Bartholow, Pearson, Gratton, & Gabiani, 2003; Sayette, 1999).

Examining alcohol in social context may also improve our understanding of the link between alcohol consumption and negative consequences that are interpersonal in nature (e.g., binge drinking, interpersonal violence, risky sexual behavior). Many people value the enhancing effects of alcohol in social situations, but consumption of alcohol often has unintended negative consequences. Research shows that alcohol consumption impairs a wide range of information processing functions (Sayette, 1999), disrupting organizational processes as well as cognitive processing capacity (e.g., Kirchner & Sayette, 2003). As a result, drinking to relieve negative affect can also bring undesirable, and often undetected, side effects, such as compromised reasoning abilities, risky decision making, and extreme social behavior (e.g., MacDonald, Zanna, & Fong, 1995, 1996; Sayette, 1993; Steele & Josephs, 1988). It is for this reason that the effects of alcohol consumption on social behavior have been described as prized *and* dangerous (Steele & Josephs, 1990). The effects of alcohol are ironic in this regard, enhancing interpersonal experience while simultaneously leading to negative interpersonal outcomes. It is interesting to note the existence of a large social psychological literature documenting similar types of effects (e.g., risky decision making) when individual behavior is compared to group behavior (e.g., Esser, 1998; Hogg, 2001). One direction for research would be to examine the degree to which alcohol consumption exacerbates these group-level effects, interacting with social context in systematic ways to increase the likelihood of risky social behavior.

One reason that few researchers have attempted to measure the effects of alcohol in social context is that capturing the effects of alcohol on social behavior in a controlled, laboratory setting is difficult. Nevertheless, advances in the measurement and analysis of social behavior make this goal more attainable than in the past (Bakeman, 1999; Sayette, Cohn, Wertz, Perrott, & Parrott, 2001). A primary aim of the present research was to use systematic behavioral observation techniques to measure the effects of alcohol on behavioral responses during an initial interaction between members of small laboratory-based groups. Combined with more traditional laboratory-based methods, this approach may provide a new perspective on the acute effects of alcohol on both subjective experience and overt social behavior. Before describing the methods and results, research on the use and effects of alcohol in social context is briefly reviewed.

1.1 Use and Effects of Alcohol in Social Context

Alcohol use is heavily influenced by the social context that surrounds consumption (e.g., Willsie & Riemer, 1980). Indeed, in many cultures drinking alcohol is commonly associated with social gathering and celebration (MacAndrew & Edgerton, 1969). Several lines of research support the notion that social context influences the initiation and maintenance of alcohol use and misuse. Peer alcohol use, for instance, is consistently one of the strongest predictors of adolescent alcohol use (Jacob & Leonard, 1994; Curran, Stice, & Chassin, 1997), and adolescent alcohol use is strongly linked to social relationships with peers (Shulenberg & Maggs, 2002). Smith, Goldman, Greenbaum, and Christiansen (1995) found that expectancies of social enhancement from drinking predicted drinking rates among a sample of adolescents over a two-year period, and that drinking rates reciprocally predicted social enhancement expectancies at termination. Among college students, normative influences have been observed to influence both drinking behavior (Perkins, 2002), and attitudes towards drinking (Prentice & Miller, 1993).

Far fewer alcohol administration studies have sought to systematically examine the effects of acute alcohol intoxication on social responses. In the remainder of this section, studies that have investigated the acute effects of alcohol on affective, cognitive, and/or behavioral responses among non-problem drinkers engaged in social interaction are reviewed. Studies in which the behavior of any participant was scripted by the experimenters are excluded (e.g., Caudill, Wilson, & Abrams, 1987; Yankofsky, Wilson, Adler, Hay, & Vrana, 1986), as interest here centers on the effects of alcohol in the context of social interaction, where participants are free to reciprocally influence one another (see Ickes & Gonzalas, 1994).

Findings from a number of studies suggest that alcohol is differentially reinforcing when consumed in social versus solitary settings. Pliner and Cappell (1974) found that the presence of two other people during alcohol consumption altered participants' interpretations of the effects of alcohol on their internal feeling states. When participants in this study drank alone, they subsequently reported experiencing physical symptoms, such as fuzzy thinking and sleepiness. Alternatively, when participants drank with others, they reported experiencing more positive affect. Data from three subsequent studies are consistent with these initial findings. Lindman (1982) and Alberto Del Porto and Masur (1984) found alcohol to increase self-reported positive affect in social versus solitary drinking contexts. More recently, Doty and de Wit (1995) replicated these findings with college students who consumed alcohol in either a social or solitary condition. Alcohol was observed to increase ratings of drug liking and euphoria only in the social condition, while ratings of dysphoria increased for subjects in the solitary condition.

To study the effects of alcohol consumption on mood and stress-reactivity in naturalistic settings, field studies have utilized intensive daily monitoring designs to assess within-person associations between alcohol and affect in social versus solitary situations (Tennen, Affleck, & Armeli, 2003). These studies are important, because they are sensitive to the ebb and flow of contextual influences, affect, and alcohol consumption as they unfold in the natural environment.

For instance, Armeli, Tennen, et al. (2003) used palmtop computers to assess alcohol consumption and social context over 30 days, and found that alcohol consumption lessened the effects of daily stressors on mood when participants drank while interacting with others, but not when they drank alone. Employing a similar design, Mohr et al. (2001) found that participants engaged in more solitary drinking on days with more negative interpersonal experiences, whereas on days with more positive interpersonal experiences they drank more in social context. Findings from these daily diary studies suggest that the reinforcing effects of alcohol may interact with social context, such that alcohol's mood enhancing effects are most likely to appear in social settings.

Findings from social context studies that have compared the effects of alcohol versus placebo are mixed. Smith, Parker, and Noble (1975a) tested the effects of alcohol administration on affective responses during social interaction in 18 male-female couples. Relative to placebo, alcohol increased self-reported positive affect (i.e., elation, giddiness, and happiness). In contrast, Fromme and Dunn (1992) administered an alcohol or placebo beverage to moderate to heavy-drinking men and found that self-reported "stimulation, dominance, pleasure, and disinhibition" all increased in response to friendly social cues, but were unaffected by beverage amount or content. Sher (1985) examined the interacting contribution of (a) alcohol versus placebo consumption, (b) social versus solitary setting, and (c) individual differences in alcohol expectancies have on alcohol's subjective effects among social drinkers. Results of this complex study are not readily interpretable. It did appear though that relative to individuals who consumed placebo alone, those who consumed either alcohol or placebo in the social condition reported experiencing more pleasure during the first hour after drinking.

Some alcohol researchers have attempted to measure the effects of alcohol on social responses unobtrusively, using observational methods. These studies have examined alcohol's effects on aspects of verbal communication. Smith et al. (1975b) transcribed 10-minutes of free discussion in dyads and observed that alcohol made social communication more disorganized relative to placebo, increasing the number of times participants interrupted each others' conversation. Rohrberg and Sousa-Poza (1976) found that alcohol, relative to placebo, increased the depth of self-disclosure coded during discussion within dyads. A limitation of both of these early studies is that the precision and reliability of the coding schemes employed are unclear. Two other studies (Samson & Fromme, 1984; Lindman, Jarvinen, & Vidjeskog, 1987), found that amount of speech increased with drinking over time, but both used especially small samples and did not include a placebo control group in their designs. It is thus difficult to know the extent to which observed effects were due to alcohol consumption or to the development of affinity over time (Moreland & Beach, 1992). Taken together, findings from the studies reviewed in this section support the notion that the acute effects of alcohol intoxication are context dependent. As such, examination of the influence that contextual factors (e.g., the presence of other people) have on the consequences of alcohol consumption could improve our understanding of alcohol's reinforcing effects.

1.2 Cognitive Mechanisms of the Effects of Alcohol

People expect alcohol to make them feel differently (Goldman, Del Boca, & Darkes, 1999), to serve as a "magic elixir" (Marlatt, 1987). In some circumstances they value the ability of alcohol to enhance positive emotion, while in others they value its ability to relieve negative emotion (Cooper et al., 1995; Cox & Klinger, 1988). Regardless, research indicates that the reinforcing effects of alcohol are most pronounced on the rising limb of the blood alcohol concentration (BAC) curve (Lukas & Mendelson, 1988; Martin, Earleywine, Musty, Perrine, & Swift, 1993). One explanation for these effects is that alcohol regulates emotional experience at the level of primary brain emotion systems, exerting its influence on subjective emotional experience and behavior in a bottom-up fashion (Fromme & D'Amico, 1999; Koob & Bloom, 1988). Alternatively, alcohol may act indirectly, disrupting processing in higher-order association areas and thus subjective experience and behavior from the top down (Stritzke, Lang, & Patrick, 1996). The bulk of empirical findings support the latter mechanism, indicating that emotional response under alcohol varies as a function of processing demands and time, within as well as between subjects and across situations (Sayette, 1999).

Theoretical models of alcohol's effects also suggest that the effects of alcohol on emotion and social behavior are due in part to the drug's effects on cognitive processing (Sayette, 1999). Hull's (1987) self-awareness model, for instance, posits that alcohol acts to selectively impair processing of self-relevant information, thereby reducing self-awareness and self-evaluation. As a consequence, alcohol is thought to dampen anxiety in situations were self-awareness and evaluation are unpleasant, and thus reinforce drinking. When it is consumed in social context, the self-awareness model predicts that by reducing self-consciousness, alcohol consumption will increase social awareness, and feelings of closeness to others (Hull, personal communication, Nov. 13, 1998).

Alternatively, Steele and Josephs (1990) contend that the effects of alcohol are not restricted to self-relevant information. Rather, according to the alcohol-myopia model (Steele & Josephs, 1990), alcohol impairs processing of all but the most immediate internal and external cues. Thus, when alcohol is consumed in social context, the alcohol-myopia model predicts that immediate social cues gain disproportionate influence over subjective experience and behavior. Taken together, the self-awareness and alcohol-myopia models suggest that when it is consumed in social context, the effects of alcohol on emotion and behavior are secondary to the drug's pharmacological effects on the processing of social information.

In sum, both theoretical models and empirical evidence support the notion that the effects of alcohol are cognitively mediated, but many questions remain unanswered. For instance, researchers agree that it is important to study the effects of alcohol on emotion (Lang et al., 1999), and it is often assumed that people value alcohol's ability to regulate emotion in social situations (Cooper, Lynne, et al., 1995), but it is unclear if alcohol affects processing of all emotional stimuli (Lang et al., 1999), or differentially affects processing of negative versus positive stimuli (Bartholow et al., 2003; Sayette, 1993). Study of the effects of alcohol in social context could shed light on these questions. When people are engaged in social interaction they are constantly encoding, interpreting, and responding to valenced social cues, such as facial expressions and speech. Alcohol may systematically alter these processes, such that positive versus negative social cues have different levels of influence over affective responses, social behavior, and subsequent self-reported subjective experience.

1.3 Measurement Issues

Measurement of social and emotional information processing under alcohol has been hampered by a lack of methods available for assessment of affective and behavioral responses (Lang et al., 1999; Sayette, 1999). Most experimental studies of alcohol reinforcement have examined the ability of alcohol to dampen participants' psychophysiological reactivity to laboratory stressors (see Greeley & Oei, 1999; Lang et al., 1999; Sayette, 1999). Ingestion of alcohol has been found to reduce stress reactivity under certain circumstances, but findings suggest that the relationship between alcohol and stress is complex, varying with the slope of the blood alcohol curve, nature of the stimulus, characteristics of the individual, and the context in which drinking occurs (Greeley & Oei, 1999; NIAAA, 2000; Sayette, 1993). Examination of the acute effects of alcohol in social context may enable researchers to better account for the contributions of these interacting factors, and to study the effects of alcohol on emotional responses other than stress.

When measuring responses in interactive social context, it is important to consider the degree to which participants are acquainted with one another, or their degree of <u>social integration</u>. Social integration refers to the extent to which members of a group have formed interpersonal (e.g., affective, cognitive) bonds (Moreland, 1987). Social integration is not an all-or-none phenomenon; like the pharmacological effects of alcohol, the development of interpersonal relationships unfolds over time, and continues for however long group members are motivated to maintain their relationship (Hamilton, Sherman, & Lickel, 1998; Morland, 1987). The focus of the present study is on the earliest stage of social integration, which occurs during an initial interaction between unacquainted strangers. This phase of social integration is typically characterized by some degree of social anxiety and heightened self-presentational concerns (Leary & Kowalski, 1995). Because people often consume alcohol to regulate social anxiety, observing the effects of alcohol during the early stages of social integration could provide an ideal context for examination of alcohol's reinforcing effects. An additional advantage of this approach is that all study groups can be observed during precisely the same stage of formation, controlling for other factors such as the groups' previous drinking experience and pre-established status structure.

Measuring affect, cognition, and behavior in social context is not a new idea. Group researchers have examined these constructs in social context for over 60 years (e.g., Lewin, 1939; Sherif, 1936), and a large body of social psychological research demonstrates that social factors are fundamental determinants of emotion, cognition, and behavior (Levine & Moreland, 1998; Levine, Resnick, & Higgins, 1993; Thompson & Fine, 1999). However, as reviewed earlier, most studies examining the effects of alcohol in social context have relied exclusively on self-report measures. Self-report measures are essential in assessing the subjective effects of alcohol, but they have important limitations, and it is likely that these limitations are exacerbated following alcohol consumption (Sher, 1987). Self-report measures cannot measure moment-to-moment fluctuations in emotional responses. Instead, when they complete self-report measures, participants aggregate their subjective experience over time, and after their responses are filtered through consciousness, they must impose language on what may be a non-verbal experience. Self-report measures are thus vulnerable to distortions and biases (Nisbett & Wilson, 1977; Stone, Turkkan, Bachrach, Jobe, Kurtzman, & Cain, 2000).

One way to bypass the limitations of self-report is to measure the effects of alcohol unobtrusively, using observational methods. Towards this end, several previous social context studies have examined the effects of alcohol consumption on speech behavior, offering preliminary evidence that alcohol affects verbal responses in dyads (e.g., Smith et al., 1975). But like most other alcohol administration studies, these studies relied entirely on traditional methods of analysis (e.g., analysis of variance; ANOVA), which assume that individual responses are independent, and thus restrict their focus to the effects of alcohol on <u>individual</u> participants' responses. A limitation of this approach is that it fails to account for the fact that speech, like other inherently social behaviors, occurs primarily in interactive, social situations.

No previous alcohol administration studies have attempted to measure the effects of alcohol on the group-level interdependence of participants' social responses, nor measure behavioral responses other than speech in social context. In the present study, we attempted to examine the effects of alcohol consumption on participants' social cognition and behavior by measuring a number of behavioral responses that occur during the initial stages of social integration, and are known to reflect processes related to person perception and social bonding. As such, the present research offers a new perspective on the effects of alcohol on social cognition and behavior during social integration, utilizing systematic behavioral observation techniques and multi-level statistical modeling to measure a range of both individual- and group-level responses to alcohol over time.

1.3.1 Systematic Behavioral Observation

Observational methods make it possible to unobtrusively measure and interpret behavioral responses as they unfold over time (Bakeman, 1999). Interest here focuses on systematic observational methods, which involve predefined operational behavior codes and a concern for inter-rater reliability (Bakeman & Gottman, 1997). Technological advances have greatly enhanced the utility of these methods, allowing researchers to capture multiple streams of ongoing behavior with a high degree of precision, improving the reliability of observed behavior codes, and making data reduction and analysis far less burdensome (e.g., see Noldus Information Technology, 2003). In particular, these methods make it possible to measure group-level, interactive responses, in addition to individual-level responses.

Systematic behavioral observation offers a number of other advantages that, when combined with traditional measures such as self-report, can refine our understanding of the effects of alcohol. First, observational measures capture participants' immediate reactions to environmental stimuli, allowing for assessment during exposure to stimuli of interest. Second, observational measures can be unobtrusive, and thus need not interfere with constructs that they are designed to measure. Third, observational measures can be collected over relatively long periods of time, and therefore allow researchers to observe response patterns within and between participants. Fourth, a significant amount of research on the validity and reliability of these measures has been conducted, and technological advances make these methods accessible. Use of these measures may advance knowledge of social behavior in general, and the effects of alcohol consumption on social behavior in particular.

Facial Expression

Facial expressions are complex behaviors that may reflect emotion (Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Cacioppo, Uchino, Crites, et al., 1992), self-presentational concerns (Depaulo & Friedman, 1998), and/or social intentions (Fridlund, 1994). Despite their complexity, anatomically based coding systems such as the Facial Action Coding System (FACS; Ekman & Friesen, 1978; 2002) have proven valuable. FACS, which has good psychometric properties (e.g., Sayette, Cohn, Wertz, Perrott, & Parrott, 2002), has enabled researchers from many fields to study facial action under controlled conditions and thus learn a great deal about processing of emotional information and emotional reactivity (Rosenberg & Ekman, 1994; Schmidt & Cohn, 2001). FACS has been used to examine the effects of alcohol on individuals (Kushner, Massie, Gaskel, MacKenzie, Fiszdon, & Anderson, 1997; Levenson, 1987; Sayette, Martin, Perrott, Wertz, & Hufford, 2001). To date however, no alcohol researchers have used FACS to measure facial action during social interaction.

Facial expressions of emotion. An important advantage of facial expression coding systems, such as FACS, is that they permit researchers to account for the emotional valence of participants' behavioral responses. FACS allows for reliable assessment of participants' immediate affective responses as they fluctuate from moment-to-moment during social interaction. As such, FACS seems well suited to study the effects of alcohol on emotion and social behavior, because the effects of alcohol are also known to fluctuate, varying with the slope of the blood alcohol curve (BAC; Marlatt, 1987).

Combined movement of the zygomaticus major muscle (FACS action unit (au) 12), and the obicularis oculi muscle (au 6), has been found to reflect positive affect (Frank, Ekman, & Friesen, 1993). Ekman (1989) labeled this smile of enjoyment the Duchenne smile (D-smile), after the French anatomist. D-smiles require more effort and are harder to fake than social smiles (Schmidt & Cohn, 2001), and have been found to be more effective in eliciting facial responses from others (e.g., Surakka & Hietanen, 1998). In the proposed study, FACS was used to code D-smiling displayed by each participant over the course of a social interaction.

Facial expressions as social signals. The FACS system was also used to measure the effects of alcohol on non-Duchenne, social smiling (i.e., au 12 in absence of au 6), which has been observed to occur during social interaction (see Schmidt & Cohn, 2001). Because they occur largely in social context, human facial expressions are generally considered to be cooperative signaling systems (Fridlund, 1997). Social smiling is not an index of positive affect per se, but it is thought to reflect positive self-presentational concerns and cooperative intention, and has been suggested to be an adaptive social signal (DePaulo, 1992; Leary, Knight, & Johnson, 1987). For instance, smiling has been found to increase perceptions of the smiler's intelligence, happiness, social status, and sociability (Schmidt & Cohn, 2001). As such, social smiling during group interaction may provide a useful index of social bonding.

Speech

Human interaction almost always involves speech, and facial expressions are intricately associated with speech production (Schmidt & Cohn, 2001). Verbal content analysis systems have proven useful (Weingart, 1997), but content analysis of large amounts of triadic conversation can be highly complex and time consuming. There is evidence that it may be just as interesting and useful to measure the amount and structure of speech as it is to measure its content (e.g., Feldstein & Welkowitz, 1987). Dabbs and Ruback (1987) contend that content-free speech is an ideal variable for research on group processes, because it is pervasive in social interaction and can be analyzed across multiple levels of analysis and to different degrees of complexity.

Empirical evidence supports this claim, suggesting that content-free speech patterns are a reliable index of social influence processes. Studies reveal that speech patterns are related to members' ratings of interpersonal attraction across individual- and group-levels of analysis. For example, Dabbs and Ruback (1984) found that individuals reported liking their group more when there was more talking and liking their group less when there was more silence. Further, group members enjoyed being in groups within which there was uncertainty about who would speak next; that is, when speaking order was not certain and participation seemed spontaneous. In another study, Dabbs and Ruback (1987) found that congruence in mean length of group members' vocalizations was related to higher reports of group attractiveness.

Behavioral Coordination

A defining characteristic of both facial expression and speech is that they require coordination; people engaged in an interaction must actively coordinate their expressions and speech to communicate effectively. This is why both Hackman and Morris (1975), and Dabbs and Ruback (1987), have equated social interaction to chess, where it is necessary to understand the sequence of moves, and not just their frequency. As such, when assessing the quality of a person's social responses, it may be important to measure group-level coordination in addition to individual response parameters such as amount of observed behavior. Consistent with Cappella (1997), the term behavioral coordination is used here to refer to mutually responsive behavior patterns between interaction partners.

Laboratory studies have demonstrated a link between non-confrontational behavioral coordination and the development of social bonds (e.g., Bernieri & Rosenthal, 1991; Cappella, 1997; Chartrand & Bargh, 1999). For example, developmental researchers have found that facial expressions serve a fundamental role in socialization, emotional communication, and social referencing during infancy (e.g., Cohn, Campbell, & Ross, 1991; Thompson, 1998). In studies among adults, facial expressions have been found to create and support interpersonal empathy (e.g., Brothers, 1989). Cappella and Flagg (1992) used time series analysis techniques to demonstrate that interactants reported feeling more attracted to one another to the extent that observed smiling behavior became coordinated over time. Likewise, the effects of viewing Ronald Reagan's reassuring smile brought about physiological signs of positive response in participant viewers, even in those who said they did not support Reagan politically (Sullivan, & Masters, 1991).

Social psychologists have used small groups as a context to examine the link between shared positive affect and behavioral coordination (Tickle-Degnen & Rosenthal, 1987). Moreland (1987) refers generally to the development of shared positive affect, or group rapport, as affective integration. Small groups research demonstrates that behavioral coordination is a correlate, antecedent, and consequence of positive affective integration (Tickle-Degnen & Rosenthal, 1987). Group researchers have found that groups with high levels of rapport are characterized by close physical proximity, expression of mutual affection, behavioral coordination, and active, inclusive conversation (Levine & Moreland, 1998; Tickle-Degnen & Rosenthal, 1987). Taken together, there is a considerable amount of empirical support for the notion that positive group experiences are associated with mutually responsive coordination of basic social behaviors during interpersonal interaction.

For the purpose of the present research, coordinated smiling was operationalized as simultaneous smiling between multiple interaction partners. It was assumed that co-occurring, mutually responsive smiling behavior reflects shared affiliative intentions and/or shared positive affect among group members. Coordinated facial expression is somewhat different than coordinated speech. In contrast to facial expression, coordinated speech is not characterized by co-occurrence (e.g., interruptions), but by the sequence of individual speaking turns within an interacting group. As such, coordinated speech was operationalized as a group-level event wherein all three group members contribute to a conversation, one after the other. As with coordinated smiling, it was assumed that in the context of a non-confrontational social interaction, coordinated speech is reflective of a positive group experience and the development of group rapport (Tickle-Degnen & Rosenthal, 1987).

Coordination of smiling and speech behavior was measured in the present study to assess the extent to which study group participants bonded over the course of an initial interaction. However, because the interaction groups were comprised of strangers, we expected that bonding would be inhibited by heightened levels of self-awareness, self-presentational concerns, and social anxiety (Leary & Kowalski, 1995). According to the self-awareness model (Hull, 1987), alcohol reduces processing of self-relevant information, and thus increases interpersonal empathy and feelings of closeness to others. To the extent that behavioral coordination is reflective of group rapport, one way to test the self-awareness model would be to examine the effects of alcohol consumption on the development of group-level behavioral coordination over time. Toward this end, we hypothesized that alcohol, consumed in non-confrontational social context, would lead to increased coordination of smiling and speech behaviors over the course of the free-drink interaction period.

1.4 Overview of the Present Research

There is great interest in understanding the reinforcing effects of alcohol. Ample evidence suggests that social factors heavily influence the initiation and maintenance of alcohol use and misuse, but few studies have systematically examined the acute effects of alcohol in social context. Non-problem, "social drinkers" rarely drink alcohol alone, yet the majority of alcohol administration studies conducted to date have examined social drinkers' responses to alcohol as they participate in isolation. Even studies examining alcohol and social anxiety typically require participants to present a speech while alone in a room (e.g., Sayette et al., 2001).

The present study represented a preliminary attempt to examine the effects of alcohol in a group setting. In particular, this study aimed to measure the acute effects of alcohol on both individual and group-level social responses during group interactions involving three strangers. Observational methods were used to measure the amount and coordination of facial expressions and speech, in order to study the effects of alcohol consumption on these behaviors during the initial stages of social integration. Given the complementary advantages and limitations of self-report and observational measures, self-reported subjective experience measures were also included, in an attempt to identify multivariate response patterns under alcohol. Measuring social responses in this way may provide a new, group-level perspective on the acute, reinforcing effects of alcohol.

Fifty-four males reporting no prior history of drug or alcohol abuse were examined. During an initial screening session, eligible social drinkers completed the Self-Monitoring Scale (SMS; Snyder, 1987), the Social Provisions Scale (SPS; Cutrona & Russell, 1987), and the Self-Consciousness Scale-Revised (SCS-R; Scheier & Carver, 1985). One week after screening, unacquainted participants completed a short form of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988; S-PANAS; Mackinnon, Jorm, Christensen, Korten, Jacomb, & Rodgers, 1999), and were assembled into three-person groups. All members of each group were administered either a moderate dose of alcohol (0.82 g/kg) or an alcohol placebo to be consumed over 30 minutes. During this interval, participants were permitted to speak freely, with the exception of discussing their degree of intoxication. All aspects of participants' interaction during this "free-drink" period were video and audio recorded with separate S-VHS cameras, enabling us to systematically code these data blind to participants' drink or group conditions. The free-drink period was divided into three, ten-minute time periods, so the effects of alcohol on behavioral responses could be examined over time. After the free drink, participants completed the S-PANAS and the Short Perceived Group Reinforcement Scale (SPGRS; see Appendix A).

1.5 Hypotheses

Hypothesized effects of alcohol on amount of observed behavior. Specific predictions presented below are derived from previous alcohol research that has shown alcohol to increase measures of positive affect and speech production. For all hypotheses below, the effects of alcohol were expected to interact with time, with greater effects occurring as alcohol was absorbed across the free-drink period.

Hypothesis 1A: A main effect of alcohol is expected, such that total duration, event duration, rate-per-minute, and total percentage of time in D-smile states will be greater among members of alcohol groups than among members of placebo groups.

Hypothesis 1B: A main effect of alcohol is expected, such that total duration, event duration, rate-per-minute, and total percentage of time spent in speech turns will be greater among members of alcohol groups than among members of placebo groups.

Hypothesized effects of alcohol on coordination of observed behavior. A primary focus of the present study is on the effects on alcohol on group-level social responses. Hypotheses concerning group-level effects are derived from the self-awareness model of alcohol use and abuse described earlier (Hull, 1987). When alcohol is consumed in non-confrontational social situations, it is expected to impair processing of self-relevant information, thereby reducing self-awareness and self-evaluation, and enhancing feelings of closeness to others.

Hypothesis 2A: Coordination of social smiles is expected to be greater in alcohol groups, such that group-level, dyadic and triadic social smile states will be more likely to occur in alcohol groups than in placebo groups.

Hypothesis 2B: Coordination of D-smiles is also expected to be greater in alcohol groups, such that group-level, dyadic and triadic D-smile states will be more likely to occur in alcohol groups than in placebo groups.

Hypothesis 2C: Speech event sequences within alcohol groups are expected to be more coordinated, such that all three members will be more likely to contribute to the conversation in alcohol than in placebo groups.

Hypothesized effects of alcohol on self-reported criterion measures. Hypotheses here are derived in part from previous alcohol research that has shown alcohol to increase ratings of positive affect and social bonding when it is consumed in social context, and from the self-awareness model described earlier (Hull, 1987), which predicts that alcohol will increase feelings of closeness to others.

Hypothesis 3A: At the end of the free drink period participants in alcohol groups are expected to rate more positive affect and less negative affect on the S-PANAS, adjusting for baseline levels, compared to placebo group members.

Hypothesis 3B: At the end of the free drink, participants in groups that consume alcohol are expected to achieve higher scores on the short perceived group reinforcement scale (SPGRS) than participants in groups that consume placebo.

2.0 METHOD

2.1 Participants

Healthy male social drinkers aged 21 to 35 were recruited via newspaper ads. Those who successfully completed a brief phone screening were invited to the Alcohol and Smoking Research Lab (ASRL) for a 20-min screening session. Participants were excluded if they reported a history of adverse reaction to the type or amount of beverage employed in the study, if they reported medical conditions that contraindicated alcohol administration, if they met DSM-IV criteria for past alcohol abuse or dependence, if they reported smoking 15 or more cigarettes/day, if they were not within 15% of ideal weight for their height, as indexed by the 1983 Metropolitan Life tables, or if they were illiterate. All those invited to participate had to report drinking an average of at least two drinks on at least one occasion per two weeks, or at least four drinks on at least one occasion per month, over the past year.

Eligible participants were invited to an experimental session. They were told to avoid: eating or drinking caffeine within 4-hrs; using alcohol or drugs within 24 hrs; and smoking for one hour prior to arrival. They also were told that breath measurement instruments would be used to confirm compliance. They were told that they could not drive themselves from the study. Those needing transportation were provided with money for a taxi or bus.

Fifty-four men participated in the experiment. They were randomly assigned to groups of three unacquainted persons. These groups were randomly assigned to receive either alcohol (9 groups, 27 participants) or placebo (9 groups, 27 participants). Ninety-three percent identified themselves as Caucasian, and 7% as African-American. Age, marital status, income, smoking status, and ethnicity were equivalent across groups.

Setting and Equipment. The three participants in each group were informed that they would consume their drinks together before the start of separate experiments to begin about 30 minutes later, and were seated equidistant from one another around a circular (75 cm diameter) table. Separate cameras faced each participant, and a common microphone was set to the side of the room. It was explained that the cameras were not recording them, but were focused on their drinks and would be used to monitor their consumption rate from the adjoining room. Vertical interval time-code (VITC) was added to the video output from each camera. Video output from each camera was recorded with the audio output to separate S-VHS tapes, and combined by a split-screen generator to form a quad-split tape that included an overhead view of the room.

2.2 Measures

2.2.1 Individual Difference Measures

Baseline individual difference measures were administered during the screening session to assess whether participants subsequently assigned to the alcohol condition would differ from those in the placebo condition on traits that could influence the measures of interest.

Demographics. Participants completed a standard demographic form regularly used at the Alcohol and Smoking Research Laboratory (ASRL; e.g., Sayette, Martin, Perrott, Wertz, & Hufford, 2001).

Drinking history and patterns. Participants completed a Drinking Patterns form which assessed the number of days out of a given week or month that they consumed any alcohol, the number of drinks they consumed on average when they drank alcohol (with 1 drink = 12 oz. beer, 5.0 oz. wine, or 1.5 oz. liquor), the number of times they had become ill after drinking in the last 6 months, and the maximum number of drinks they thought they could drink within a 30 minute period without feeling ill as a result.

Self-Monitoring Scale (SMS; Snyder, 1987). This scale assesses level of sensitivity to cues about the situational appropriateness of one's social behavior and a willingness and ability to use these cues as guidelines for regulating and controlling self-presentations.

Social Provisions Scale (SPS; Cutrell & Russell, 1987). The SPS measures the amount and quality of social support resources available to respondents.

Self-Consciousness Scale-Revised (SCS-R; Scheier & Carver, 1985). This scale assesses levels of dispositional private and public self-consciousness. Private self-consciousness refers to the tendency to direct attention inward on private aspects of the self, whereas public self-consciousness refers to the tendency to direct attention to public aspects of the self.

2.2.2 Self-report Criterion Measures

Short Positive and Negative Affect Schedule (SPANAS; Mackinnon, Jorm, Christensen, Korten, Jacomb, & Rodgers, 1999). This measure comprises two independent affect scales designed to assess state positive and negative affect. The short form consists of ten items, as opposed to the twenty item original PANAS scale (Watson, Clark, & Tellegen, 1988).

Short Perceived Group Reinforcement Scale (SPGRS; Appendix A). This measure is designed to assess participants' subjective experience within their group. More specifically, the SPGRS includes items that assess group attraction and belongingness. The attraction items (1, 5, and 6) were adapted from the Group Attitude Scale developed by Evans and Jarvis (1986), while the belongingness items (2, 3, and 4) were adapted from the Perceived Cohesion Scale (Bollen & Hoyle, 1990).

2.2.3 Beverage-related Measures

Blood Alcohol Concentration (BAC). BACs were recorded using a DataMaster breath alcohol instrument (National Patent Analytical Systems, Mansfield, Ohio). The DataMaster calibrates infrared measurement systems prior to each test with an accuracy of +/-0.003% at BAC of .1%. The DataMaster was custom-designed for false BAC display in the placebo conditions.

Subjective Intoxication Scale (SIS). Participants estimated their perceived intoxication level with the SIS. They were asked to use a 0 to 100 point scale where 0 = “not intoxicated at all” and 100 = “the most intoxicated I have ever been.”

Post-experimental questionnaire. Participants estimated the number of ounces of vodka they had consumed, and were asked to estimate the highest level of subjective intoxication they had experienced during the experiment using the same 0 to 100 point scale. These items have been included in prior studies in our lab (e.g., Sayette, Martin, Perrott, Wertz, & Hufford, 2001).

2.3 Procedure

Predrink assessment. On arrival, participants’ height and weight were recorded. They also ate a light, weight-adjusted meal (a bagel with butter), and completed a consent form, which described the study. To test for sobriety, an initial BAC reading was obtained and participants were asked to rate their subjective intoxication using the SIS.

Drink administration. Drinks were mixed in front of participants to increase credibility in the placebo conditions (Rohsenow & Marlatt, 1981). A researcher brought a tray containing a chilled vodka bottle and a bottle of chilled cranberry juice cocktail (Ocean Spray) into the participant's room. For those drinking alcohol, the vodka bottle contained 100-proof vodka (Smirnoffs); for those administered a placebo, the vodka bottle contained flattened tonic water (Schweppes). Alcohol participants received a 0.82g/kg dose of alcohol, which for a 150 lb. male translates to approximately 5.00 ounces of vodka. The alcoholic beverage was one part vodka and 3.5 parts juice. In the placebo group, the glass was smeared with vodka to enhance credibility of the placebo. Total beverage was isovolemic in the alcohol and placebo conditions. Previous work shows that this drink procedure provides a successful execution of the placebo manipulation (Sayette et al., 2001a), the goal of which was to lead participants to believe they had consumed alcohol (Martin & Sayette, 1993).

Beginning at time zero, participants in the alcohol condition were administered one third of a 0.82g/kg dose of alcohol and asked to consume it evenly over a 10-min period. At 10 and 20-min, participants received the middle and final thirds of the beverage, respectively, and were asked to drink it evenly over the ten minute intervals. Immediately after the final third was finished (30-min), participants were asked to rinse their mouths with water and then invited to remain in the room and relax for 5 minutes.

<u>Postdrink assessment</u>. BAC and SIS ratings were recorded approximately 40 minutes after the start of drink administration for all participants. All participants were presented with a false BAC reading ranging from .045% to .047% (randomly assigned), which is about the highest credible reading for deceived participants (Martin & Sayette, 1993). Actual BAC levels also were recorded.

Following completion of the free-drink period, group members completed a structured interaction task and memory task which are reported elsewhere. Upon completion of the study, BAC and SIS measures were obtained. At this point placebo participants were presented with a false BAC reading between .036% and .038% (randomly assigned), and were asked to complete the post-experimental questionnaire asking them to describe the study's purpose and to estimate their alcohol intake and level of intoxication throughout the experiment, were debriefed, paid $50.00, and allowed to leave. Alcohol participants recorded their BACs, ate lunch, and were allowed to rest, read, or listen to music. When BACs fell below .04%, they were asked to complete the post-experimental questionnaire. Participants were then debriefed, during which it was explained that their expressions and speech had been videorecorded during the free-drink period. Informed consent to use the videotaped data was obtained for all participants. When BACs dropped below .025%, they were paid $50 for their participation. Before leaving the ASRL, participants who had consumed alcohol were reminded not to drive or operate heavy machinery for the rest of the evening.

Behavior Coding

D-smiles, social smiles, and speech were scored separately for each participant by a trained coder who was blind to participants' drink condition and to the behavior of other group members. To accomplish this, videotapes were coded with Observer Video-Pro Software (Observer 4.1, Noldus Information Technology, 2003). The Observer system makes it possible to synchronize group members' data according to the VITC time-code stamped on each videotape, and thus allows independent coding of each participant while the sequential structure of each within group interaction is preserved. Three brief periods totaling approximately 4 minutes, during which an experimenter entered the room to refill participants' drinks, were excluded from the data set.

D-smiling and social smiling was coded according to the FACS system (Ekman & Friesen, 2002). As noted above, social, non-Duchenne smiling involves action of the zygomaticus major (au 12) muscle, whereas D-smiling involves co-action of the zygomaticus major muscle and the obiclaris oculi muscle (au 6 +12). To code social smiling, a certified FACS coder (TK) recorded onset and offset times of au 12 for all participants using the Observer system. Once observer agreement had been verified by another FACS-certified coder (KG; see below) the primary coder returned to the segments of each tape that included au 12 to code onset and offset times for au 6.

Two independent coders coded participants' speech behavior. To account for complexities introduced by triadic conversation, speech behavior was coded according to Dabbs and Ruback's (1987) Grouptalk model. The Grouptalk model is an extension of the system Jaffe and Feldstein (1970) designed to code the temporal organization of sound and silence during speech. The Grouptalk model includes the same codes as the Jaffe and Feldstein (1970) system, as well as codes for group vocalizations. Within the Grouptalk model, an individual turn consists of an individual speaker's vocalizations and pauses. A pause that ends a speaker's turn is a switching pause. During an individual's turn, overlapping speech from one other group member is called simultaneous speech, whereas overlapping speech from both other members is called a group vocalization.

Inter-rater Agreement

For comparison purposes, a certified FACS coder used the same coding procedure to independently code randomly selected segments of data during the beginning, middle, and end of the primary coder's work. Coders were considered in agreement if both coded the same behavior during the same 1s sampling interval. Videotapes of all 12 participants from 4 of the study groups (half alcohol; approximately 22% of the sample) were coded for each of the behavioral variables, and Cohen's kappa statistic was calculated to assess inter-rater agreement corrected for chance. Kappa values for all behaviors indicated that the coders achieved an acceptable level of agreement. For au 12, kappas ranged from .89 – .93 (M = .91). For au 6+12, kappas ranged from .90 – .96 (M = .93). For speech, kappas ranged from .85 – .98 (M = .91).

Data Reduction

Time-based behavioral codes for each participant were merged to form a single data file for each group according to their original time-stamped sequential order. The data file for each group was then divided into 1 s sampling intervals, as the sampling interval for sequential analysis should be briefer than the shortest-duration behavior of interest to ensure that the same behavior is not coded multiple times per sampling interval (Sackett, 1979). The three members of each group were labeled A, B, or C, according to their original randomly assigned position around the experimental table. Behavioral counts and descriptive statistics for each participant's behavior were then calculated.

Counts and descriptive statistics for mutually-exclusive, individual, dyadic, and triadic behavior states within each group were also calculated. Within each 1 s sampling interval, none of three (~ABC), one of the three (A~BC, B~AC, or C~AB), two of the three (AB~C, AC~B, or BC~A), or all three (ABC) participants in a given group can display the same target behavior. In an initial step, frequency counts for each of eight possible individual, dyadic, or triadic behavior states were calculated across the interaction period for each group. Because the reference labels for individual behaviors (A~BC, B~AC, C~AB), and for dyadic behaviors (AB~C, AC~B, BC~A), were assigned arbitrarily, these counts were further collapsed, with individual and dyadic counts summed within each group to form a single individual and dyadic behavior count for each group. In addition, event sequences were calculated for participants' speech behavior within each group, using onset times of individual speech turns as event markers. All behavior counts, along with associated descriptive statistics, were exported to the SAS system for further analysis.

Data Analysis Strategy

The primary aim of the data analyses was to investigate the effects of alcohol consumption on participants' behavioral and self-report responses. The study utilized a hierarchically nested experimental design; all participants assigned to a given group received the same level of treatment (i.e., alcohol or placebo). As such, participants were nested within groups, and groups were nested within one of the two treatment conditions. Two general approaches were taken to test the specific study hypotheses, each of which is described in more detail below. The first, more traditional, approach involves the use of ANOVA to examine the effects of alcohol on individual participants' behavioral and self-reported responses. The second approach utilizes categorical modeling, the aim of which is to measure the effects of alcohol on the relative likelihood of group-level behavior states over time.

Continuous modeling of behavioral and self-report responses. Given the nested structure of these data, it was important to account for the potential interdependence of participants' responses when assessing the effects of alcohol consumption (Kenny & Judd, 1986). Accordingly, the study groups within which subjects were nested were included in the analyses as a random factor. In contrast to a fixed factor, whose levels are chosen to represent a contrast of interest to a researcher, a random factor is one that represents a sample drawn from a larger population (Jackson & Brashers, 1994; Kenny & Kashy, 2000; Littel et al., 2001). As such, the study groups constructed for the present study represent a random sample of possible groups that could have been formed from eligible men in the general population.

When conducting ANOVA with random factors, testing the effects of interest involves estimating both the variance contributed by individual differences between subjects, and the variance contributed by differences between levels of the random factor (Jackson & Brashers, 1994). The second source of random variance affects the composition of appropriate test statistics for assessing the significance of the fixed factor. In the present design, the random study Group factor was nested within the fixed Drink factor. If group membership accounts for a significant amount of response variance, the appropriate denominator for the F test of the fixed factor is not the traditional within-groups mean square, but the mean square for Group nested within Drink. However, in line with the recommendations of Kenny and Kashy (2000), if between study-group variance does not explain a significant amount of response variance, the random group factor is dropped from the analysis and the within-groups mean square is used instead.

Categorical modeling of individual, dyadic, and triadic behavior states. The first set of analyses examined individual responses to alcohol, controlling for study-group membership. These analyses did not indicate the relative likelihood of group-level individual, dyadic, and triadic behavior states over time. As described earlier, the behavior state of the members of each study group was coded during each second of the 30 minute interaction period. To address the hypothesized effects of alcohol on the coordination of participants' social behavior, the behavioral response data for each group were entered into multidimensional contingency tables. Frequency counts for each mutually exclusive level of the behavioral response were classified according to the drink condition of each study group and the time period within which the behavior occurred. Hypotheses concerning coordination of behavior were then analyzed with categorical modeling techniques.

Log-linear modeling techniques were developed to analyze multidimensional contingency tables, allowing researchers to examine relationships between categorical variables with additive modeling techniques similar to the familiar ANOVA (Agresti, 2002; Bakeman & Gottman, 1997). In log-linear modeling, the multiplicative relations among joint and marginal counts in a contingency table are transformed into additive ones by transforming the counts to logarithms (Agresti, 2002). Thus, as with ANOVA, log-linear models are linear, and may consist of main effects and interactions (Cohn & Tronick, 1987). However, standard log-linear models make no distinction between response and explanatory variables, instead treating all variables as nominal, unordered factors.

Logit models, which are closely related to log-linear models, are more useful when causal relationships between known independent variables and a dependent response are of interest (Agresti, 2002). When there is a single response variable (e.g., D-smiles in the present design), logit models are better suited for confirmatory hypothesis testing, because they describe how the log odds for one response variable depends on other explanatory variables (Agresti, 2002). In fact, given a single response variable, each logit model for that response is equivalent to a log-linear model (Agresti, 2002; Friendly, 2000). In the current study, the SAS program Proc CATMOD was used to build and test logit models that describe the relationship between participants' behavioral responses and the experimental alcohol manipulation across each of the time periods in the free-drink.

Event-sequential analysis of speech behavior. In contrast to facial expression, coordinated speech is not characterized by co-occurrence (e.g., interruptions), but by the sequence of individual speaking turns within each group. When examining the order of events, it is useful to remove time (i.e., event durations) from the analysis, because accounting for the duration of events often makes it difficult to examine their sequence (Dabbs & Ruback, 1987). Thus, to examine the way group members' speech turns were sequenced, we further reduced our state-sequential data to event-sequential data (Bakeman & Quera, 1995). Whereas state-sequential data preserves both the duration and order of behavioral responses, event-sequential data involves only the sequential order of individual responses.

Event-sequential analysis techniques allow for modeling of patterns of interdependency of data as social interaction unfolds over time (Bakeman & Gottman, 1997). To examine the distribution of speech turns within each group, we calculated the number of times a participant's vocalization failed to elicit a vocal response from one of the other group members, the number of times a vocalization led to a dyadic exchange between two of the group members, and the number of times a vocalization lead to a triadic exchange between all members of the group across the entire interaction period. Frequency counts for these speech event sequences were entered into a contingency table, and classified according to the drink condition of each study group, and the time period within which each sequence occurred. Poisson regression techniques were used to estimate the rate of incidence for these counts, and the relationship between the counts and the explanatory variables Drink and Time (Agresti, 2002; Stokes, Davis, & Koch, 2000).

3.0 RESULTS

3.1 Manipulation Check

Participants consuming alcohol reached mean BACs of .051% (SD = .009) following the free-drink period (minute 40), and reached a peak BAC of .067% (SD = .014) about 35 minutes later (minute 70). Thus, as expected, participants drinking alcohol were on the ascending limb of the BAC curve. Three measures examined the effectiveness of placebo manipulations, each revealing significantly greater effects for alcohol, compared to placebo participants (ps < .0006). The postdrink SIS revealed placebo participants to report lower levels of intoxication (M = 18.3, SD = 14.6) than did those drinking alcohol (M = 35.4, SD = 19.4). On the postexperimental questionnaire, participants consuming alcohol reported drinking 5.7 oz. (SD = 2.4) of vodka, and reported an overall level of intoxication during the study of 40.7 (SD = 18.7), compared to 4.1 oz. (SD = 2.1) and a 20.5 (SD = 14.1) intoxication level for placebo participants. Importantly, all participants in both alcohol and placebo groups reported drinking at least 1 ounce of vodka. In sum, consistent with our prior studies, the placebo manipulation was successful in leading participants to believe they had consumed alcohol and to experience some level of intoxication (e.g., Sayette, Martin, Perrott, Wertz, & Hufford, 2001; Sayette & Wilson, 1991).

3.2 Baseline Individual Differences

Demographics. Participants' age, marital status, income, smoking status, and ethnicity were equivalent across groups. Seventy percent of the sample were nonsmokers, who were evenly distributed across the two experimental conditions (ps > .22).

Drinking history. Participants in the alcohol and placebo conditions responded similarly to questions concerning drinking history and current drinking patterns (ps > .15). Overall, participants reported drinking an average of 4.26 (0.92) days a week, consuming an average of 3.96 (2.26) drinks (defined as 12 oz beer, 5.0 oz wine, or 1.5 oz liquor) per occasion, becoming ill from drinking an average of 0.63 (0.94) times in the last 6 months, and predicted that they could drink an average of 4.87 (2.21) drinks in a 30 minute period without becoming ill as a result.

SPANAS. A one-way ANOVA with drink condition as the between group factor indicated that pre-drink scores on the positive and negative affect scales of the SPANAS did not differ between the drink conditions, Fs (1,52) < 1.50, ps > .24.

Trait individual difference measures. A series of independent t tests with drink condition as the between groups factor confirmed that at baseline, participants in the alcohol and placebo conditions responded similarly on the Self Monitoring Scale ($t(52) = .11$, $p > .90$), the Social Provisions Scale ($t(50) = 1.76$, $p > .08$), and the public ($t(50) = .45$, $p > .65$), private ($t(51) = .38$, $p > .70$), and social ($t(50) = .11$, $p > .91$) subscales on the Self-Consciousness Scale.

3.3 Effects of Alcohol on Amount of Observed Behavior

Prior to testing our primary hypotheses concerning the effects of alcohol on group-level responses, we examined the effects of alcohol on the amount of individual participants' D-smiling and speech behavior. To do this we employed traditional between-group analyses, controlling for time and for interdependence due to study-group assignment. Hypotheses concerning the effects of alcohol on the occurrence of D-smiling and speech are tested below.

Hypothesis 1A: *A main effect of alcohol is expected, such that total duration, event duration, rate-per-minute, and total percentage of time in D-smile states will be greater among members of alcohol groups than among members of placebo groups.* Table 1 presents means for parameters associated with individual participants' D-smiling across each time interval and for the entire interaction period. In an initial step, we examined whether the effects of alcohol on participants' responses changed significantly across the three time periods in the free-drink.

A series of Drink X Time repeated measures ANOVAs was conducted, with each of the four D-smile response parameters as the repeated variable. These analyses revealed that there was no

Drink X Time interaction, $\underline{F}$s (2, 104) < 0.50, $\underline{p}$s > .6, indicating that the effects of alcohol consumption on participants' D-smiling behavior did not differ across the three time periods. Because there was no evidence that the effects of alcohol changed over time, we collapsed across the three time periods and used participants' cumulative responses during the free-drink. Next, we estimated the component of response variance accounted for by group membership, and examined the effects of alcohol when this random source of between group variance was controlled. SAS PROC MIXED was used to estimate random and fixed components of variance (Table 2), and the RANDOM statement in SAS PROC GLM was used to conduct a series of random coefficient ANOVAs.

Table 1. *Mean (SD) au 6+12 parameters by drink condition and time*

	Time 1	Time 2	Time 3	Overall
Alcohol (n = 27)				
total duration (seconds)	40.0 (31.7)	38.7 (27.9)	38.2 (26.1)	142.1(94.7)
percent of interval	7.0 (5.0)	6.0 (5.0)	6.0 (4.0)	8.0 (5.0)
event duration (seconds)	3.0 (1.3)	3.0 (1.4)	2.8 (1.1)	3.0 (0.2)
rate/minute	1.3 (0.9)	0.6 (0.4)	0.4 (0.3)	1.5 (0.9)
Placebo (n = 27)				
total duration (seconds)	37.6 (26.8)	35.3 (26.8)	36.1 (28.5)	135.3 (88.8)
percent of interval	6.0 (4.0)	6.0 (4.0)	6.0 (5.0)	8.0 (5.0)
event duration (seconds)	3.1 (1.8)	2.9 (1.8)	3.1 (1.7)	3.3 (1.5)
rate/minute	1.2 (0.7)	0.5 (0.3)	0.4 (0.2)	1.3 (0.7)

Note: Time 1 = 0-10 min; Time 2 = 10-20 min; Time 3 = 20-30 min.

Results indicated that the random Group factor explained a highly significant amount of variance for total duration, percentage, and rate, $\underline{F}$s (16,36) > 4.45, $\underline{p}$s < .0001, but not for event duration of participants' smiling behavior, $\underline{F}$ (16,36) < 1.36, $\underline{p}$ > .21. Because group membership accounted for a significant amount of response variance for duration, percentage and rate of D-smiling, the appropriate denominator for the F test of the effects of alcohol on these responses was the mean square for Group nested within drink (Kenny & Kashy, 2000). These analyses indicated that controlling for the clustering effects of Group membership, the effects of alcohol consumption on duration, percentage, and rate of D-smiling were nonsignificant, $Fs\ (1,16) < .44$, $ps > .52$. Because group membership did not explain a significant amount of variance in the mean duration of D-smiles, the traditional within-groups mean square was justified for testing the effects of alcohol. A one-way ANOVA with drink condition as the between group factor revealed that there was no overall main effect of alcohol consumption on speech event duration, $F\ (1,52) = 0.47$, $p > .50$. In sum, alcohol consumption did not appear to affect the amount of participants' D-smiling behavior.

Table 2. *Random and fixed effects for au 6 + 12*

		Estimate	SE	Prob
Total duration	Random effects			
	Group	4701.13	2167.28	**0.0150**
	Residual	4083.94	962.59	<.0001
	Fixed Effects			
	Intercept	142.14	25.9539	<.0001
	Drink	-6.8193	36.7044	**0.8549**
Event duration	Random effects			
	Group	0.1654	0.2492	**0.2534**
	Residual	1.4008	0.3302	<.0001
	Fixed Effects			
	Intercept	3.0419	0.2651	<.0001
	Drink	0.2315	0.3749	**0.5456**
Rate/minute	Random effects			
	Group	0.4775	0.1950	**0.0072**
	Residual	0.2160	0.05092	<.0001
	Fixed Effects			
	Intercept	1.5247	0.2471	<.0001
	Drink	-0.2272	0.3495	**0.5249**

Note: Intraclass correlation coefficient = Group estimate / (Group estimate + random residual)

Hypothesis 1B: *A main effect of alcohol is expected, such that total duration, event duration, rate-per-minute, and total percentage of time spent in speech turns will be greater among members of alcohol groups than among members of placebo groups.* In a parallel set of analyses, we examined whether the effects of alcohol on participants' speech responses changed significantly across the three 10-minute time periods in the free-drink. Table 3 presents means for parameters associated with participants' speech across each time interval and for the entire interaction period.

Table 3. *Mean (SD) speech parameters by drink condition and time*

	Time 1	Time 2	Time 3	Overall
Alcohol (n = 27)				
total duration (seconds)	110.9 (75.3)	111.0 (95.8)	133.2 (82.7)	420.0 (282.2)
percent of interval	18.0 (13.0)	19.0 (16.0)	22.0 (14.0)	23.0 (16.0)
event duration (seconds)	9.8 (9.5)	10.1 (11.1)	10.9 (10.5)	10.6 (2.2)
rate/minute	1.5 (0.9)	0.6 (0.4)	0.5 (0.3)	1.7 (0.9)
Placebo (n = 27)				
total duration (seconds)	105.4 (61.1)	118.0 (72.8)	114.4 (76.8)	391.9 (214.8)
percent of interval	18.0 (10.0)	20.0 (12.0)	19.0 (13.0)	22.0 (12.0)
event duration (seconds)	7.3 (4.8)	9.3 (7.8)	8.3 (5.5)	8.0 (4.5)
rate/minute	1.6 (0.8)	0.7 (0.4)	0.5 (0.3)	1.7 (0.8)

Note: Time 1 = 0-10 min; Time 2 = 10-20 min; Time 3 = 20-30 min.

A series of Drink X Time repeated measures ANOVAs was conducted, with each of the four speech response parameters as repeated variables. These analyses revealed that there were no Drink X Time interactions, Fs (2,104) < 1.4, ps > .25, indicating that the effects of alcohol consumption on participants' speech behavior did not differ across the three time periods. Because there was no evidence that the effects of alcohol changed over time, we collapsed across the three time periods and used participants' cumulative responses during the free-drink to test the hypothesized effects of alcohol.

Table 4. *Random and fixed effects for speech*

		Estimate	SE	Prob
Total duration	Random effects			
	Group	0	.	.
	Residual	62874	12331	<.0001
	Fixed Effects			
	Intercept	419.96	48.2561	<.0001
	Drink	-28.0278	68.2444	**0.6867**
Event duration	Random effects			
	Group	17.1527	10.8487	**0.0569**
	Residual	37.1935	8.7666	<.0001
	Fixed Effects			
	Intercept	10.5533	1.8120	<.0001
	Drink	-2.5637	2.5626	**0.3320**
Rate/minute	Random effects			
	Group	0.0768	0.1307	**0.2785**
	Residual	0.7572	0.1785	<.0001
	Fixed Effects			
	Intercept	1.6877	0.1912	<.0001
	Drink	0.0506	0.2705	**0.8539**

Note: Intraclass correlation coefficient = Group estimate / (Group estimate + random residual)

Next, we estimated the component of response variance accounted for by group membership, and examined the effects of alcohol when this random source of between group variance was controlled. SAS PROC MIXED was used to estimate random and fixed components of variance (Table 4), and the RANDOM statement in SAS PROC GLM was used to conduct a series of random coefficient ANOVAs. Results indicated that the random Group factor did not account for a significant amount of the variance for total duration, percentage, and rate of participants' speech behavior, Fs (16,36) < 1.31, ps > .24, but did explain a significant amount of the variance in speech event duration, F (16,36) > 2.38, p < .01). Because group membership accounted for a significant amount of response variance for speech event duration, the appropriate denominator for the F test of the effects of alcohol on this response was again the mean square for Group nested within drink.

This analysis indicated that controlling for the clustering effects of Group membership, the effects of alcohol consumption on speech event duration was nonsignificant, F (1,16) = 1.0, p > .33. Because group membership did not explain a significant amount of variance in total duration, percentage, or rate of speech, the traditional within-groups mean square was justified for testing the effects of alcohol. A series of one-way ANOVAs with drink condition as the between group factor revealed that there was no overall main effect of alcohol consumption on these speech parameters, Fs (1,52) < 0.2, ps > .60.

In summary, traditional between groups analyses, controlling for study-group membership, indicate that alcohol consumption did not affect the amount of individual participants' speech or smiling behaviors. In addition to examining these individual-level social reponses, we were particularly interested in the effects of alcohol on group-level social responses. The next set of analyses test the effects of alcohol consumption on group-level coordination of participants' reponses using categorical analysis techniques.

3.4 Effects of Alcohol on Coordination of Observed Behavior

To examine the relative likelihood of individual, dyadic, and triadic behavior states over the interaction period, we reduced the individual behavioral response data within each group to mutually exclusive behavior counts. Frequency counts for the individual, dyadic, and triadic behavior states (au 12, au 6+12, speech), were then classified in contingency tables by the time period and drink condition in which they occurred. For each hypothesis, we evaluated the fit of logit models that included terms for the effects of alcohol and time. The selection process was guided by evaluation of the individual parameter estimates, as well as by the overall fit of the model. This model selection process was an exploratory approach to examining the observed pattern of influence that alcohol consumption had on behavior responses over time. A series of odds ratios was used to test the significance of effects revealed during model selection, as well as to examine further the nature and direction of these effects.

Hypothesis 2A: *Group-level coordination of social smiles (au12) was expected to be greater in alcohol groups, such that transitions from individual to dyadic social smile states, and from dyadic to triadic social smile states, would be more likely in alcohol groups than in placebo groups.* Table 5 presents logit models (with the corresponding log-linear symbol), along with likelihood ratio chi-square statistics and their associated p-values. These goodness-of-fit statistics indicate how closely cell frequencies estimated from each model compare with the observed frequencies. In contrast to significance testing in ANOVA, a significant chi-square value indicates a lack of association between the explanatory and response variables. An acceptable model is one that provides a nonsignificant fit to the observed frequencies and contains the fewest necessary parameters (Cohn & Tronick, 1987).

For all models listed in Tables 5 and 6, S refers to behavior State, which is the response variable, T refers to the Time factor, and D refers to the Drink factor, which are the explanatory variables. Model 1 is the saturated model. To determine the most parsimonious model, we used a step-up method, beginning with the basic means [intercept] model (Agresti, 2002; Model 2 below). From examination of the parameter estimates and fit statistics for models 2 through 5, we found that inclusion of terms for both Time and Drink (Model 5) provided a better fit than a model that included neither or only one of these terms (Models 2, 3, and 4). In the next series of models (6 through 8), we found that the term for the Time x Drink interaction provided a better fit than any of the main effects models (Model 6), especially when the Time term was retained (Model 8). These results suggest that alcohol consumption and time had an interactive effect on participants' individual versus group-level behavior states; however, the fit statistics still indicated that this model had some lack-of-fit to the observed data table.

Table 5. *Model selection for au 12 data*

	Logit model	Log-linear symbol [1]	DF	Chi-square	Prob
1.	$\alpha + \beta_i^{T} + \beta_k^{D} + \beta_{ik}^{TD}$	[STD]	0	.	.
2.	α	[S, TD]	10	87.16	.0001
3.	$\alpha + \beta_i^{D}$	[SD, TD]	8	76.52	.0001
4.	$\alpha + \beta_k^{T}$	[ST, TD]	6	61.80	.0001
5.	$\alpha + \beta_i^{D} + \beta_k^{T}$	[SD, ST, TD]	4	51.66	.0001
6.	$\alpha + \beta_{ik}^{TD}$	[STD]	6	40.50	.0001
7.	$\alpha + \beta_i^{D} + \beta_{ik}^{TD}$	[STD]	2	28.81	.0001
8.	$\alpha + \beta_i^{T} + \beta_{ik}^{TD}$	[STD]	2	13.39	.0012
9.	$\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=1)}$	[SD(T=1)]	2	35.49	.0001
10.	$\boldsymbol{\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=2)}}$	**[SD(T=2)]**	**2**	**1.32**	**.5174***
11.	$\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=3)}$	[SD(T=3)]	2	42.38	.0001
12.	$\alpha + \beta_i^{D} + \beta_k^{D(T=2)}$	[SD(T=2)]	4	30.14	.0001
13.	$\boldsymbol{\alpha + \beta_i^{T} + \beta_k^{D(T=2)}}$	**[SD(T=2)]**	**4**	**3.09**	**.5431***

Note: S= State response; T = time; D = drink
* acceptable fit to the observed data

Because the interaction term seemed to have a relatively large effect (Model 6), in the next series of steps (Models 9 through 11), we unpacked the interaction term by nesting the effect of Drink within Time, which is equivalent to fitting separate models, State = Drink, for each level of Time (Friendly, 2000). Here the strong effects of the Drink(Time=2) term (Model 10), and nonsignificant effects of the Drink(Time=1) and Drink(Time=3) terms (Models 9 and 11), are apparent. The likelihood ratio chi-square indicated there was no significant lack of fit for Model 10, so we accepted Model 10 as providing an acceptable fit to the observed data. In a final step, we examined the relative influence of the Time and Drink terms by dropping each respectively from Model 10. Model 12 indicated that removing Time from the model leads to a lack-of-fit, whereas Model 13 indicated that removal of the Drink term from the model does not. This suggests that while there is an effect of Time on State across the interaction period, the effect of Drink primarily occurred during time period 2 (minutes 10 to 20 of the free-drink period; see Figure 1).

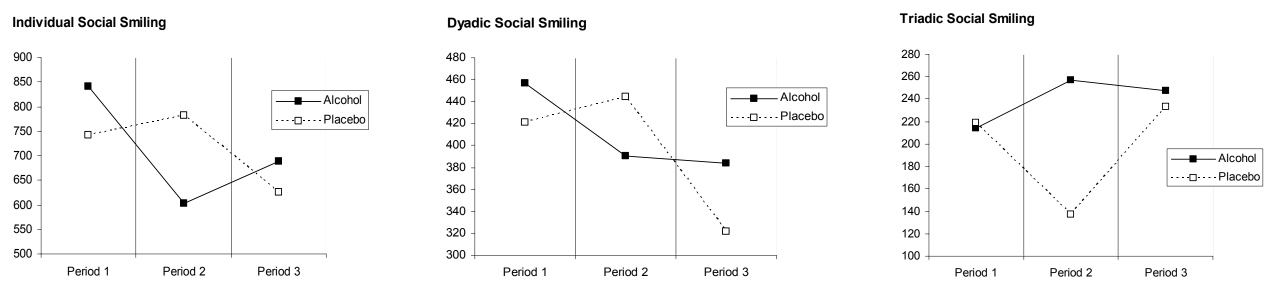

Figure 1. *Social smiling (au 12) in seconds by drink and time*

To test the significance of the effects of alcohol on social smiling (au 12) during time period 2, and to further examine the nature and direction of these effects, we calculated a series of odds ratios contrasting the effects of alcohol versus placebo across the free-drink. These odds ratio analyses indicate that during time period 2, triadic social smile states were 2.42 times (95% CI: 1.92-3.06) more likely than individual social smile states, and 2.13 times (95% CI: 1.66-2.73) more likely than dyadic social smile states in alcohol versus placebo groups. Consistent with the fit of our model, all other odds ratio contrasts across the free-drink were nonsignificant, ORs < 1.14. Stated differently, these findings reflect the fact that during time period 2, alcohol groups spent 1 second in a triadic social smile state for every 21 seconds that elapsed, whereas placebo groups spent 1 second in a triadic social smile state for every 40 seconds that elapsed.

Hypothesis 2B: *Group-level coordination of D-smiles (au 6 +12) were expected to be greater in alcohol groups, such that transitions from individual to dyadic D-smile states, and from dyadic to triadic D-smile states, would be more likely to occur in alcohol groups than in placebo groups.* Table 6 presents the model selection process for the au 6+12, D-smile data. Examination of the parameter estimates and fit statistics for models 2 through 5, indicated that once again, the inclusion of terms for both Time and Drink (Model 5) provided a better fit than a model that included neither or only one of these terms (Models 2, 3, and 4). In the next series of models (6 through 8), we found that the term for the Time x Drink interaction provided a better fit than any of the main effects models (Model 6). In fact, unlike the analysis for au 12, we found that the model including the main effect for Time and the Time x Drink provided an acceptable fit to the observed data (Model 8).

Table 6. *Model selection for au 6 + 12 data*

	Logit model	Log-linear symbol [1]	DF	Chi-square	Prob
1.	$\alpha + \beta_i^{T} + \beta_k^{D} + \beta_{ik}^{TD}$	[STD]	0	.	.
2.	α	[S, TD]	10	27.88	.0019
3.	$\alpha + \beta_i^{D}$	[SD, TD]	8	10.05	.0064
4.	$\alpha + \beta_k^{T}$	[ST, TD]	6	25.10	.0015
5.	$\alpha + \beta_i^{D} + \beta_k^{T}$	[SD, ST, TD]	4	15.12	.0045
6.	$\alpha + \beta_{ik}^{TD}$	[STD]	6	13.83	.0316
7.	$\alpha + \beta_i^{D} + \beta_{ik}^{TD}$	[STD]	2	10.50	.0327
8.	$\boldsymbol{\alpha + \beta_i^{T} + \beta_{ik}^{TD}}$	**[STD]**	**2**	**3.29**	**.1934***
9.	$\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=1)}$	[SD(T=1)]	2	6.96	.0308
10.	$\boldsymbol{\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=2)}}$	**[SD(T=2)]**	**2**	**1.74**	**.4197***
11.	$\alpha + \beta_i^{D} + \beta_k^{T} + \beta_k^{D(T=3)}$	[SD(T=3)]	2	14.45	.0007
12.	$\boldsymbol{\alpha + \beta_i^{D} + \beta_k^{D(T=2)}}$	**[SD(T=2)]**	**4**	**12.20**	**.0576***
13.	$\boldsymbol{\alpha + \beta_i^{T} + \beta_k^{D(T=2)}}$	**[SD(T=2)]**	**4**	**3.92**	**.4164***

Note: S= State response; T = time; D = drink
* acceptable fit to the observed data

Although Model 8 provides an acceptable fit, we continued the selection process in order to assess the effects of alcohol across each level of time. Thus, we included a nested interaction term as before, and again found that the model including the Drink(Time=2) interaction term (Model 10) explained most of the variance in the data, providing the only nonsignificant chi-square. Lastly, we examined the relative influence of the Time and Drink terms by removing the Time term (Model 12), and then the Drink term (Model 13), and found that although neither results in a significant lack of fit, the Time factor was playing a larger role than the Drink factor. These results indicate that the effects of alcohol on participants' group-level behavior states changed over time, such that the effects of alcohol on D-smiling was most pronounced during time period 2 (see Figure 2).

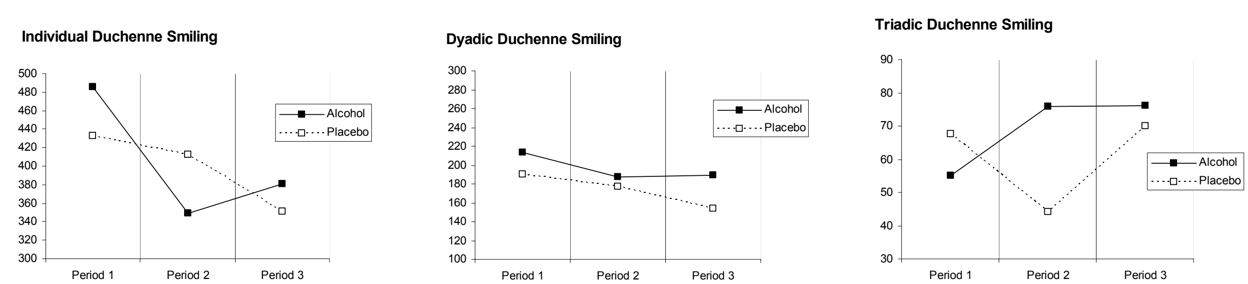

Figure 2. *D-smiling (au 6 + 12) in seconds by drink and time*

As before, we examined the significance and direction of the Drink X Time effects identified by the model selection process above with a series of odds ratios contrasting the effects of alcohol versus placebo across the free-drink. The odds ratio analyses indicate that during time period 2, triadic D-smile states were 2.04 times (95% CI: 1.37-3.04) more likely than individual D-smile states, and 1.62 times (95% CI: 1.10-2.48) more likely than dyadic social smile states in alcohol versus placebo groups. Consistent with the fit of our model, all other odds ratio contrasts across the free-drink were nonsignificant ORs < 1.26. Stated differently, during period 2 alcohol groups spent 1 second in a triadic social smile state for every 71 seconds that elapsed, whereas placebo groups spent 1 second in a triadic social smile state for every 123 seconds that elapsed.

Hypothesis 2C: *Group-level speech event sequences within alcohol groups were expected to be more coordinated, such that all three members will be more likely to contribute to the conversation in alcohol than in placebo groups.* To test this hypothesis, event-sequential analyses were used to examine the effect of alcohol consumption on the coordination of speech within each group. As described earlier, we quantified the number of times a participant's vocalization was not reciprocated, the number of times a vocalization led to a dyadic exchange between two of the group members (Dyad), and of particular interest, the number of times a vocalization led to a triadic exchange between all members of the group (Triad). Table 7 presents observed and expected counts for the dyadic and triadic speech event sequences classified by drink condition and time.

Across the entire free-drink period, we found a significant main effect of alcohol consumption on triadic speech events, X^2 (1, N = 54) = 8.83, $p < .003$, but not on individual or dyadic speech events, X^2s (1, N = 54) < 1.5, $p > .24$. A significant Drink X Time interaction emerged for dyadic speech events, X^2 (2, N = 54) = 17.9, $p < .000$, as well as a trend towards a Drink X Time interaction for triadic speech events, X^2 (2, N = 54) = 5.28, $p < .07$, but not for individual speech events, X^2 (2, N = 54) = 0.29, $p > .80$. These findings indicate that the effects of alcohol consumption were restricted to group-level, coordinated speech events, and that these effects were most pronounced during the last 20 minutes of the free-drink. Given this preliminary evidence of an interaction between the Drink and Time factors, we further examined the link between alcohol consumption and speech within each level of time for the dyadic and triadic event sequences.

Table 7. *Observed (Expected) speech event sequence counts by drink condition and time*

		Alcohol	Placebo	Chi-square	Prob
Time 1	Dyad	293 (294.2)	295 (293.8)	0.01	.93
	Triad	84 (89.2)	72 (66.8)	0.92	.34
Time 2	Dyad	**217 (251.2)**	**285 (250.9)**	9.24	.00**
	Triad	67 (73.7)	60 (54.3)	0.39	.53
Time 3	Dyad	**327 (291.7)**	**256 (291.3)**	8.67	.00**
	Triad	**91 (80.1)**	**49 (59.9)**	12.8	.00***

Notes: Time 1 = 0-10 min; Time 2 = 10-20 min; Time 3 = 20-30 min
** = .01 level; *** = .001 level

Table 7 presents X^2 statistics for the effects of Drink condition on dyadic and triadic speech events within each time period. It is apparent that a greater number of dyadic exchanges occurred among placebo groups during time period 2. This pattern was unexpected, and is somewhat difficult to interpret. However, it appears that this pattern was reversed between time periods 2 and 3, such that dyadic speech events were significantly more likely to occur within alcohol groups. Of particular interest, the effects of alcohol on promotion of triadic exchanges emerged during the final 10-minute interval. Importantly, the effects of alcohol on triadic speech events during time period 3 do not appear to be secondary to the effects of alcohol on dyadic speech events. Although more dyadic events occurred in alcohol groups during time period 3, approximately 30% of these resulted in triadic events, whereas only about 20% of dyadic events resulted in triadic events among placebo groups during time 3. Together, findings suggest that as alcohol was absorbed, the likelihood of each group member engaging in the conversation respectively increased.

3.5 Effects of Alcohol on Self-reported Criterion Measures

Table 8 presents means for the self-report criterion measures, along with Cohen's d effect size estimates (Cohen, 1988). SAS PROC MIXED was used to estimate random and fixed components of variance, so as to determine the appropriate denominator for the F tests of the effects of alcohol consumption. Results suggest that the random Group factor did not account for a significant amount of the variance for either the PANAS or the PGRS scores (Fs $(16,36) < 1.66$, ps $> .10$). Therefore, the within-groups mean square was used as the denominator for the F test of fixed effects due to drink condition.

Hypothesis 3A: *At the end of the free drink period participants in alcohol groups are expected to rate more positive affect and less negative affect on the S-PANAS, adjusting for baseline levels, compared to placebo group members.* An analysis of covariance (ANCOVA) with drink condition as the between group factor and time 1 SPANAS scores as the covariate indicated that, there was no influence of alcohol consumption on positive affect ratings, $F\ (2,51) < 3.5$, $p > .07$. The only significant effects of alcohol consumption were to increase ratings of negative emotion following the free drink, $F\ (2,51) > 5.81$, $p < .01$.

Hypothesis 3B: *At the end of the free drink, participants in groups that consume alcohol are expected to achieve higher scores on the short perceived group reinforcement scale (SPGRS) than participants in groups that consume placebo.* A one-way ANOVA with drink condition as the between group factor indicated that, although in the expected duration, the effect of alcohol consumption on individual responses to the post drink SPGRS did not reach significance, Fs (1,52) < 0.17, ps > .68.

Table 8. *Mean (SD) PANAS and SPGRS scores by drink condition, n = 54*

		Alcohol	Placebo	F (1, 52)	d
SPANAS	POS 1	17.2 (4.6)	15.8 (4.1)	1.41	.32*
	POS 2	14.4 (4.5)	11.9 (3.6)	5.06*	.39*
	NEG 1	7.6 (1.9)	7.6 (1.8)	0.01	.02
	NEG 2	14.7 (3.9)	12.2 (3.5)	5.92*	.63**
		Alcohol	Placebo	F (1, 52)	d
SPGRS		39.7 (10.5)	38.6 (8.7)	0.17	.11

Note: * d = small (> .20; Cohen, 1988); ** d = medium (> .50); *** d = large (> .80)

4.0 DISCUSSION

People often drink alcohol for social reasons. Indeed, alcohol consumption is commonly valued for its ability to both enhance positive affect and dampen anxiety in social situations. Consequentially, social factors heavily influence the initiation and maintenance of alcohol use and misuse, and many negative outcomes related to alcohol consumption are interpersonal in nature. Yet experimental studies have seldom attempted to examine the acute effects of alcohol in social context. Reliable methods for investigating the effects of alcohol on social responses have not been used, and the influence of alcohol on the encoding and interpretation of higher-order, social information remains unclear. As such, the present research sought to examine the utility of a new approach to studying the acute effects of alcohol consumption on person perception and social behavior.

The overarching findings of the present study were that alcohol consumption, compared to placebo, increased group-level, social responses during the group interaction, while alcohol appeared to have no effect on individual-level behavioral or self-report responses. Stated differently, although alcohol consumption did not increase self-reported social bonding or positive affect, or the overall *amount* of participants' behavior, it did increase group-level *coordination* of smiling and speech over time. It is apparent from these results that had we restricted analysis to traditional, or mixed-model, ANOVA, we would have failed to detect some interesting findings regarding the effects of alcohol on social behavior. The present findings indicate that the effects of alcohol are context dependent to a significant degree, and assuming that concurrent smiling and balanced speech among group members are indicative of positive interactions (Dabbs & Ruback, 1987; Schmidt & Cohn, 2001), the present data suggest that one of the reasons people value the effects of alcohol in social situations is that it facilitates the process of group formation among strangers.

4.1 Individual Responses

We hypothesized that relative to placebo, alcohol consumption would increase the amount of D-smiling and speech observed during a non-structured interaction between strangers. This prediction, which was based on previous work demonstrating that alcohol increases positive affect and speech production in social situations (e.g., Doty & de Wit, 1995; Smith et al, 1975b), was not supported. There are a number of possible explanations for the absence of an effect of alcohol on individual participants' behavioral responses. First, restricting participation in the social interaction paradigm to unacquainted strangers may have reduced the effects of alcohol on behavioral expressions of positive affect. As described earlier, restricting participation to strangers allowed us to examine the effects of alcohol on the initial stages of group formation in all groups, as well as to rule out the effects of influences such as pre-established status structure or previous group drinking experiences. However, this approach contrasts with that of previous social context studies, which have not restricted participation to strangers (Doty & de Wit, 1995). For instance, in the Smith et al. studies (1975a, 1975b), participants were spousal or close friend couples who volunteered to participate together.

Alternatively, we may have failed to detect effects of alcohol on individual participants' behavior responses because of the fundamental role these basic social behaviors play in interpersonal communication during face-to-face interaction. When they are assessed within the context of an ongoing social interaction, facial expressions and speech are likely to be highly context dependent. As a consequence, one reason we did not observe significant effects of alcohol on individual participants' behavior responses is that a very large proportion of the total response variance for these measures was accounted for by within-group clustering due to study group membership. For instance, the intraclass correlation coefficient for total duration of D-smiling is .54 (calculated from Table 2). This value reflects an extremely high level of within-group interdependence for this variable, and indicates that the total duration of each participant's D-smiling behavior was heavily influenced by the total duration of their fellow group members' D-smiling behavior (Cohen, Cohen, West, & Aiken, 2003). Taken together, results from the individual-level analyses indicate that participants' smiling and speech responses reflected the smiling and speech of their group members more than the content of their drink, or individual differences in more stable personality characteristics known to influence responses to alcohol (see Baer, 2002).

4.2 Group Responses

We hypothesized that alcohol consumption would increase group-level coordination of D-smiling, social smiling, and speech behavior. Coordination of smiling was operationalized as group-level, dyadic and triadic co-occurrence, whereas coordination of speech was operationalized as group-level, second order speech-event sequences. As predicted, alcohol appeared to increase observed coordination of both smiling and speech behaviors, with more pronounced effects occurring as alcohol was absorbed over time. These results suggest that alcohol consumption did not affect how much participants smiled or spoke, but did affect when and with whom they smiled and spoke. These findings are consistent with our hypothesis that alcohol consumption focuses attention on immediate social stimuli, although it is difficult to know the degree to which this effect is primary or secondary to alcohol's effects on emotion. Alcohol may dampen emotional arousal directly, thereby reducing the emotional impact of immediate contextual stimuli, or it may dampen emotional arousal indirectly, by altering the initial appraisal of immediate contextual stimuli. Regardless, the present study provides preliminary evidence that group-level social responses may be a sensitive measure of the effects of alcohol, and that multivariate measures that cross individual and social levels of analysis could broaden our perspective of alcohol's acute reinforcing effects.

The present findings suggest that we could learn a great deal about the effects of alcohol by measuring its influence on the wide range of social responses that occur in interactive context. For instance, the present paradigm offers a new, group-level perspective on the association between alcohol and emotion. Our findings regarding the effects of alcohol on coordination of positively valenced facial expressions provides support for the notion that the effects of alcohol on positive affect are moderated by the social context that surrounds consumption. This is significant because few experimental studies have examined the acute effects of alcohol on positive affect. Following his extensive review of the alcohol-emotion literature, Lang et al. (1999) contend that "considering the...major role of both negative and positive affect in drinking behavior and its consequences, it is puzzling that so few investigators have sought to study the full range of affects and to measure emotional valence specifically."

Social integration. Our findings concerning the effects of alcohol on group-level responses may be understood from within a social psychological framework. Social psychologists have theorized that people define themselves in terms of their interpersonal relationships and social group memberships (Brewer & Gardner, 1996; Hogg, 2001). According to social identity theory (Tajfel & Turner, 1986), for instance, individuals derive their self-concept from their membership in certain social groups. Others assume that forming social bonds is a fundamental human motivation (e.g., Brewer, 1991). Baumeister & Leary (1995) propose that people possess a pervasive need to belong, or motivation to form and maintain positive interpersonal relationships. As a consequence, people are heavily influenced by the behavioral conventions, cognitive expectancies, and status structure of the social groups to which they belong, and they learn to value behaviors that facilitate the development of interpersonal relationships (Baumeister & Leary, 1995).

Alcohol is commonly valued for its positive effects on social interaction, and consumption in social context may be reinforcing to the extent that it reduces social anxiety and satisfies the drinker's motivation to belong. However, the present data do not address this hypothesis directly. Instead, ad hoc laboratory-based groups, such as those created for the present study, provide a glimpse of the effects of alcohol on an early stage in the process of social integration. Individual-group relationships are known to change in systematic ways over time, with both the individual and the social group serving as potential sources of influence (Levine & Moreland, 1994). As discussed earlier, Moreland (1987) refers generally to the continuous process of group formation as social integration. Research shows that when individuals interact they influence each other affectively, cognitively, and behaviorally, forming social bonds over time (Moreland, 1987). Thus, one way to interpret the present findings regarding triadic coordination is to suggest that alcohol facilitated the process of social integration in our ad hoc groups of strangers.

4.3 Time

Alcohol administration studies that have sought to examine the effects of alcohol on emotional responses typically have relied on either self-report or psychophysiological measures of stress response dampening (Lang et al., 1999). For example, one of the only studies that measured the effects of alcohol on responses to both positive and negatively valenced stimuli employed startle probe techniques (Stritzke, Patrick, & Lang, 1995). A drawback of these methods is that they do not tell us much about the interaction between alcohol and emotion as it unfolds within the context of everyday social situations. The present research offered a glimpse of the effects of alcohol on positively valenced facial expressions and speech as they unfold in social context over a relatively long period of time. There are new complexities to this approach; nonetheless, advantages of these measures are that they can be collected unobtrusively over extended periods of time, and may generalize more readily to the real world.

For all of the behavioral response measures in the present study, we hypothesized that the effects of alcohol would emerge as alcohol began to be absorbed. Because there is little precedent for our measurement procedure, our aim in analyzing the pharmacological effects of alcohol on the ascending limb was exploratory. Generally, we expected a linear effect, such that the effects of alcohol would increase with elapsed time and absorption. This prediction was supported for all measures of group-level behavioral coordination, with more pronounced effects occurring as alcohol was absorbed, although the observed effects were somewhat different for facial expressions than for speech.

As expected, there were no differences in smiling behavior between alcohol and placebo groups during the first 10 minutes of the free drink. However, differences emerged during the second time period, as alcohol increased coordination of social and D-smiles (see Figures 1 and 2). In the third period, behavioral coordination in placebo groups appeared to "catch up" with that displayed in the alcohol groups (see Figures 1 and 2). It is not obvious why the differences in smiling behavior between Drink conditions did not hold during time period three. One possibility is that the observed pattern of results reflect ceiling effects, due either to restrictions related to our paradigm or to the natural occurrence of coordinated smiles. In subsequent work it will be useful to contrast the effects of alcohol and placebo conditions with a non-alcohol control condition. Regardless, were this finding replicated, it would suggest that alcohol speeds up the process of social bonding in small groups of strangers.

As with the smile data, we observed no differences in speech during the first 10 minutes of the free drink. In contrast to the effects observed for smiling behavior, however, the effects of alcohol on coordination of speech did not emerge until the third period (Table 7). One explanation for the differential effects of alcohol on smiling and speech over time is that these behaviors utilize and reflect different cognitive resources. That is, we may not have observed effects of alcohol on coordinated speech, which involves a more cognitively effortful behavioral response, until participants had reached a higher BAC and were experiencing more marked effects. Of course, these effects require replication before firm conclusions can be drawn.

4.4 Self-report Responses

Results did not support the hypothesis that participants who consumed alcohol would report higher levels of positive affect, lower levels of negative affect, and achieve higher scores on the SPGRS after the free-drink. One reason for the lack of significant effects of alcohol on these self-report outcomes may be that the observed effects of alcohol consumption on group-level behavioral coordination reflects subtle aspects of group formation that our self-report measures were not sufficiently sensitive to detect. It is possible, for instance, that some behavioral aspects of social integration occur outside of conscious awareness, and thus are not available to participants when they respond to self-report questions.

Self-report measures are vulnerable to a range of distortions and biases that may be exacerbated by alcohol consumption (Sher, 1987). The limitations of self-report may be particularly evident in the current study, because participants were asked to aggregate their subjective experience over 30 minutes. It is likely that participants experienced a range of emotions during the free-drink period, all varying in intensity, but they were asked to describe their experience only once, retrospectively. This highlights the limitation of self-report when assessing moment-to-moment fluctuations in affective experience. It is hard to know which aspects of the free-drink period participants were referring to when they completed the post-drink questionnaires.

Contrary to our predictions, results for participants' responses to the PANAS indicate that consumption may have actually increased participants' reported negative affect. This result is somewhat difficult to reconcile with previous work, as it contradicts self-report findings from a number of previous studies (e.g., Doty & de Wit, 1995). One potential explanation for this discrepancy is the fact that unlike previous work, the current social interaction paradigm required participants to interact with a group of strangers for a relatively long period of time (30 minutes). Because interacting with strangers can be anxiety provoking, this paradigm may be better suited for increasing ratings of negative affect, related to social anxiety, than studies using friends. Thus, to the degree that alcohol intoxication magnifies the intensity of present emotions (e.g., Steele & Josephs, 1990), the strangers recruited in the present study may have reported higher levels of negative affect following alcohol versus placebo consumption because intoxication intensified social anxiety experienced during the free-drink.

4.5 Limitations

Limitations of the present study should be noted. First, the study included only a single dose of alcohol, so we were not be able to examine dose-response effects. Second, a non-alcohol control group was not included. This made it difficult to determine the extent to which the observed effects were due to differences in alcohol intoxication per se, or to differences in subjective perceptions of intoxication. The placebo condition in the present design allows measurement of the pharmacological effects of alcohol while attempting to control for some non-pharmacological influences such as alcohol expectancies, but without a control group that neither expects nor receives alcohol, we were unable to estimate the relative magnitude of non-pharmacological influence in this study.

Third, only unacquainted male participants participated in the study. The decision to limit recruitment in this way was based on a desire to decrease the likelihood that observed effects would be due to gender effects or other social factors such as pre-established status structures. In particular, inclusion of women in future studies could improve the generalizability of results. In addition, recruiting pre-established, “real”, groups in the future would provide a glimpse of the effects of alcohol on a different, later stage of social integration, when social anxiety and self-presentational concerns are less salient. In previously acquainted groups, both and alcohol and placebo participants may be more expressive and engaged, and generally perceive the free-drink period to be more pleasant than did participants in the current study.

Fourth, as noted below the study design offers relatively low statistical power for some analyses, especially to detect group-level or moderator effects with ANOVA. However, this last limitation is partially remedied by the relatively large amount of time-based data that was collected for this study. Lastly, we restricted our analysis of speech responses to content-free analyses of sequential speaking order over time. An interesting direction for future work would be to examine the verbal content of groups’ conversation in addition to its structure, as this would offer an additional measure of the valence as well as the depth of the conversations participants engage in under alcohol versus placebo. For instance, to the degree that alcohol intoxication lowers self-presentational concerns, alcohol versus placebo consumption may increase levels of self-disclosure.

4.6 Implications

The present research has methodological, clinical, and conceptual implications. From a methodological perspective, researchers have often failed to consider social context when studying the acute effects of alcohol. No previous alcohol administration studies have measured the effects of alcohol on the group-level interdependence of participants' social responses, nor measure behavioral responses other than speech in social context. Moreland (1987) contends that the process of group formation involves affective, cognitive, behavioral, and environmental elements. Accordingly, research that aims to examine the effects of alcohol in social context would likely profit from a broader range of measures. The combination of systematic behavioral observation techniques and conditional statistics offers a new approach to studying the impact of alcohol on multivariate response systems during social interaction. As such, the present research promises to set the stage for a program of research using new methods and analyses that incorporate the moderating influence of social context and time into the analysis of alcohol's acute effects on emotion and behavior.

From a clinical perspective, study of the effects of alcohol in social context could help us account for important individual differences in response to alcohol, and thus to identify risk factors that predict sensitivity and/or vulnerability to misuse. For instance, Schuckit and his colleagues (e.g., Schuckit & Smith, 2001) have found that particular responses to alcohol in the laboratory among those with a family history of alcoholism predict problem drinking twenty years later. It is likely that the ability to predict clinical outcomes from laboratory responses will improve further if the responses tested in the laboratory better reflect meaningful phenomena in the real world. The use of a "social" experimental paradigm may provide such a research advance, complimenting other work that has sought to measure the ongoing effects of alcohol in naturalistic settings (e.g., Tennen, Affleck, & Armeli, 2003).

Future studies of alcohol in social context might examine the role of individual differences by recruiting subsets of drinkers with personality characteristics known to be associated with differential responses to alcohol. For example, this social interaction paradigm could provide an ideal setting for examination of the interaction between alcohol and individual differences in social anxiety. Presumably, people who are high in social anxiety would appraise an unstructured interaction with strangers as more negative and stressful than those low in social anxiety. As such, socially anxious people may value the negatively reinforcing effects of alcohol in social context more than those low in social anxiety (Hull, 1987). Observing the effects of alcohol among certain subgroups could thus elucidate alcohol's reinforcing properties, and identify those who are at elevated risk for misuse. This approach could change our perspective on the association between alcohol and social anxiety, from one essentially based on phasic stress reactivity, to one that includes ongoing emotion regulation in the face of ongoing social stress, such as that experienced by a social phobic during a party.

Lastly, the present research could contribute conceptually to existing models of alcohol use and abuse, which suggest that the effects of alcohol on emotional responding and social behavior are cognitively mediated, but fail to systematically account for the highly variable effects of alcohol on the processing of different kinds of information. Evidence now suggests that the effects of alcohol on cognitive processing are not restricted to self-relevant information, or to controlled versus automatic processing (Kirchner & Sayette, 2003; Sayette, 1999). Rather, the effects of alcohol are broad, altering the appraisal of both internal and external stimuli in complex ways over time. Examination of these effects in social context is thus indicated, as the effects of alcohol should be especially robust in social settings, where a large number of subtle, complex, and emotionally valenced cues are present.

NOTES

1. Log-linear models are traditionally hierarchical, indicating that each model includes all lower-order terms contained in a higher-order model term (Agresti, 2002). For example, saturated model (Model 1) is hierarchical, because it contains the interaction term β_{ik}^{TD}, as well as both lower-order main-effect terms β_i^T and β_k^D. Hierarchical log-linear models are identified by shorthand notation that lists only their highest-order terms, assuming the presence of all lower-level terms (Agresti, 2002; Friendly, 2000). As a result, standard log-linear notation cannot express lower-order effects present in non-hierarchical logit models. The log-linear symbols corresponding to logit models 1, 6, 7, and 8 are thus the same (STD), despite the fact that they contain different lower-level main-effect terms, because each of these logit models includes the three-way interaction term β_{ik}^{TD}.

APPENDIX A: Short Perceived Group Reinforcement Scale

Please indicate the extent to which you agree or disagree with the statements below using the following scale. A rating of "1" indicates that you strongly agree and a rating of "9" indicates that you strongly disagree. For all items, please refer to the group with which you are participating in today's study.

Agree	1	2	3	4	5	6	7	8	9	Disagree

1. I like this group.	1 2 3 4 5 6 7 8 9
2. The members of this group are interested in what I have to say.	1 2 3 4 5 6 7 8 9
3. I agree with the members of this group on most things.	1 2 3 4 5 6 7 8 9
4. I see myself as an important part of this group.	1 2 3 4 5 6 7 8 9
5. I feel included in this group.	1 2 3 4 5 6 7 8 9
6. In spite of individual differences, a feeling of unity exists in this group.	1 2 3 4 5 6 7 8 9

BIBLIOGRAPHY

Agresti, A. (2002). *Categorical Data Analysis*. New York: Wiley-Interscience.

Alberto del Porto, J., & Masur, J. (1984). The effects of alcohol, THC, and diazepam in two different social settings. A study with human volunteers. *Research Communications in Psychology, Psychiatry, and Behavior, 9*(2), 201-212.

Armeli, S., Tennen, H., Todd, M., Carney, M., A., Mohr, C., Affleck, G., et al. (2003). A daily process examination of the stress-response dampening effects of alcohol consumption. *Psychology of Addictive Behaviors, 17*(4), 266-276.

Bachman, J., G., Johnston, L., D., O'Malley, P., M., & Bare, D., E. (1985). *Monitoring the Future Occasional Paper No. 18: The monitoring the future follow-up surveys: A desription of key experiences during the first years after high school.* Ann Arbor, MI: Institute for Social Research.

Baer, J., S. (2002). Student factors: Understanding individual variation in college drinking. *Journal of Studies on Alcohol, Supplement No. 14*, 40-53.

Bakeman, R. (1999). Behavioral observation and coding. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 138-159). Cambridge, U.K. ; New York: Cambridge University Press.

Bakeman, R., & Gottman, J. M. (1997). *Observing interaction: An introduction to sequential analysis* (2nd ed.). Cambridge: Cambridge University Press.

Bakeman, R., & Quera, V. (1995). Log-linear approaches to lag-sequential analysis when consecutive codes may and cannot repeat. *Psychological Bulletin, 118*(2), 272-284.

Bartholow, B., D., Pearson, M., Grattan, G., & Fabiani, M. (2003). Effects of alcohol on person perception: A social cognitive neuroscience approach. *85*(4), 627-638.

Baumeister, R., F., & Leary, M., R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin, 117*(3), 497-595.

Bernieri, F., J., & Rosenthal, R. (1991). Interpersonal coordination: Behavior matching and interactional synchrony. In R. Feldman, S. & B. Rime (Eds.), *Fundamentals of Nonverbal Behavior*. Cambridge: Cambridge University Press.

Bollen, K., A., & Hoyle, R., H. (1990). Perceived cohesion: A conceptual and empirical examination. *Social Forces, 69*, 479-504.

Brewer, M., B. (1991). The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin, 17*, 475-482.

Brewer, M., B., & Gardner, W. (1986). Who is this "we"? Levels of collective identity and self representations. *Journal of Personality and Social Psychology, 71*, 83-93.

Brothers, L. (1989). A biological perspective on empathy. *American Journal of Psychiatry, 146*, 10-19.

Cacioppo, J., T., Uchino, B., N., Crites, S., L., Snydersmith, M., A., Smith, G., Berntson, G., G., et al. (1992). Relationship between facial expressiveness and sympathetic activation in emotion: A critical review, with emphasis on modeling underlying mechanisms and individual differences. *Journal of Personality and Social Psychology, 62*(1), 110-128.

Cappella, J., N. (1997). Behavioral and judged coordination in adult informal social interactions: Vocal and kinesic indicators. *Journal of Personality and Social Psychology, 72*(1), 119-131.

Cappella, J., N., & Flagg, M., E. (1992, July). Interactional adaption, expressiveness and attraction: Kinesic and vocal responsiveness patterns in initial liking. *Paper presented at the International Society for the Study of Social and Personal Relationships, Orono, ME*.

Caudill, B. D., Wilson, G., Terrance, & Abrams, D., B. (1987). Alcohol and self-disclosure: Analyses of interpersonal behavior in male and female social drinkers. *Journal of Studies on Alcohol, 48*, 401-409.

Chartrand, T., L., & Bargh, J., A. (1999). The chameleon effect: The perception-behavior link and social interaction. *Journal of Personality and Social Psychology, 76*(6), 893-910.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cohn, J., F., Campbell, S., B., & Ross, S. (1991). Infant response in the still-face paradigm at 6 months predicts avoidant and secure attachment at 12 months. *Development and Psychopathology, 3*(4), 367-376.

Cohn, J., F., & Tronick, E., Z. (1987). Mother-infant face-to-face interaction: The sequence of dyadic states at 3, 6, and 9 months. *Developmental Psychology, 23*(1), 68-77.

Cooper, M., Lynne, Frone, M., R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology, 69*(5), 990-1005.

Cox, W., M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology, 97*(2), 168-180.

Curran, P., J., Stice, E., & Chassin, L. (1997). The relation between adolescent alcohol use and peer alcohol use: A longitudinal random coefficients model. *Journal of Counseling and Clinical Psychology, 65*(1), 130-140.

Cutrona, C., E., & Russell, D., W. (1987). *The provisions of social relationships and adaptation to stress* (Vol. 1). New York: JAI Press Inc.

Dabbs, J., M. , & Ruback, R., Barry. (1987). Dimensions of group process: Amount and structure of vocal interaction. In *Advances in Experimental Social Psychology* (Vol. 20, pp. 123-169): Academic Press, Inc.

Dabbs, J.M., & Ruback, R..B. (1984). Vocal patterns in male and female groups. *Personality and Social Psychology Bulletin, 10*, 518-525.

Dabbs, J.M., Ruback, R.B., & Evans, M., S. (1987). Grouptalk: Patterns of sound and silence in group conversation. In A. Siegman, W. & S. Feldstein (Eds.), *Nonverbal Behavior and Communication* (2nd ed., pp. 501-520). Hillsdale, N.J.: Erlbaum.

Davidson, R. J., Ekman, P., Saron, C., S., Senulis, J., A., & Friesen, W. V. (1990). Approach-withdrawal and cerebral asymmetry: Emotion expression and brain physiology I. *Journal of Personality and Social Psychology, 58*(2), 330-341.

DePaulo, B., M. (1992). Nonverbal behavior and self-presentation. *Psychological Bulletin, 111*, 203-243.

DePaulo, B., M., & Friedman, H., S. (1998). Nonverbal Communication. In D. T. Gilbert, S. T. Fiske & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 2, pp. 3-40). Boston: McGraw-Hill.

Doty, P., & de Wit, H. (1995). Effects of setting on the reinforcing and subjective effects of ethonol in social drinkers. *Psychopharmacology, 118*, 19-27.

Ekman, P. (1989). The argument and evidence about universals in facial expressions of emotion. In H. Wagner & A. Manstead (Eds.), *Handbook of Social Psychophysiology* (pp. 143-164). Chichester: John Wiley Ltd.

Ekman, P., & Friesen, W. V. (1978). *Facial Action Coding System: A Technique for Measurement of facial movement*. Palo Alto, CA: Consulting Psychologists Press.

Ekman, P., Friesen, W. V., & Hagar, J., C. (2002). *Facial Action Coding System on CD-Rom*. Salt Lake City, UT: Network Information Research.

Esser, J.K., (1998). Alive and well after 25 years: A review of groupthink research. *Organizational Behavior and Human Decision Processes, 73*, 116-141.

Evans, N., J., & Jarvis, P., A. (1986). The group attitude scale: A measure of attraction to group. *Small Group Research, 17*(2), 203-216.

Feldstein, S., & Welkowitz, J. (1987). A chronography of conversation: In defense of an objective approach. In A. Siegman, W. & S. Feldstein (Eds.), *Nonverbal Behavior and Communication* (2nd ed., pp. 435-499). Hillsdale, NJ: Erlbaum.

Frank, M., G., Ekman, P., & Friesen, W. V. (1993). Behavioural markers and recognizability of the smile of enjoyment. *Journal of Personality and Social Psychology, 64*, 83-93.

Fridlund, A., J. (1994). *Human Facial Expression*. San Diego: Academic Press.

Fridlund, A., J. (1997). The new ethology of human facial expressions. In J. Russell & J. Fernandez-Dols, M. (Eds.), *The Psychology of Facial Expression* (pp. 103-129). New York: Cambridge University Press.

Friendly, M. (2000). *Visualizing Categorical Data*. Cary, NC: SAS Institute Inc.

Fromme, K., & D'Amico, E., J. (1999). Neurobiological bases of alcohol's psychological effects. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 422-455). New York: Guilford Press.

Fromme, K., & Dunn, M., E. (1992). Alcohol Expectancies, social and environmental cues as determinants of drinking and perceived reinforcement. *Addictive Behaviors, 17*, 167-177.

Goldman, M., S., Del Boca, F., K., & Darkes, J. (1999). Alcohol expectancy theory: The application of cognitive neuroscience. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 203-246). New York: Guilford Press.

Greeley, J., & Oei, T. (1999). Alcohol and tension reduction. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 14-53). New York: Guilford Press.

Griffiths, R., R., Bigelow, G., E., & Liebson, I. (1978). Relationship of social factors to ethanol self-administration in alcoholics. In P. Nathan, E., G. A. Marlatt & T. Loberg (Eds.), *Alcoholism: New Directions in Behavioral Research and Treatment* (pp. 351-379). New York: Plenum Press.

Hackman, J., R., & Morris, C., G. (1975). Group tasks, group interaction process, and group performance effectiveness: A review and proposed integration. In L. Berkowitz (Ed.), *Advances in Experimental Social Psychology* (Vol. 8, pp. 45-99). New York: Academic Press.

Hamilton, D., L., Sherman, S., J., & Lickel, B. (1998). Perceiving social groups: The importance of the entativity continuum. In C. Sedikides, J. Schopler & C. Insko, A. (Eds.), *Intergroup cognition and intergroup behavior*. Mahwah, NJ: Erlbaum.

Hogg, M., A. (2001). Social categorization, depersonalization, and group behavior. In M. Hogg, A. & R. Tindale, S. (Eds.), *Blackwell Handbook of Social Psychology: Group Processes* (pp. 56-85). Oxford, UK: Blackwell.

Hull, J., G. (1987). Self-awareness model. In H. T. Blane & K. E. Leonard (Eds.), *Psychological theories of drinking and alcoholism* (pp. 272-304). New York: Guilford Press.

Hussong, A., M. (2003). Social influences in motivated drinking among college students. *Psychology of Addictive Behaviors, 17*(2), 142-150.

Ickes, W., & Gonzalez, R. (1994). "Social" cognition and social cognition: From the subjective to the intersubjective. *Small Group Research, 25*(2), 294-315.

Jackson, S., A., & Brashers, D., A. (1994). *Random Factors in Anova*. Thousand Oaks, CA: Sage Publications.

Jacob, T., & Leonard, K. (1994). Family and peer influences in the development of adolescent alcohol abuse. In R. Zucker, G. Boyd & J. Howard (Eds.), *The Development of Alcohol Problems: Exploring the Biopsychosocial Matrix of Risk. NIAAA Research Monograph No. 26, NIH Publication No. 94-3495* (pp. 123-155). Rockville, Md.: Department of Health and Human Services.

Jaffe, J., & Feldstein, S. (1970). *Rhythms of Dialogue*. New York: Academic Press.

Kahler, C., W., Read, J., P., Wood, M., D., & Palfai, T., P. (2003). Social environmental selection as a mediator of gender, ethnic, and personality effects on college student drinking. *Psychology of Addictive Behaviors, 17*(3), 226-234.

Kenny, D., A., & Judd, C. M. (1986). Consequences of violating the independence assumption in analysis of variance. *Psychological Bulletin, 99*(3), 422-431.

Kenny, D., A., & Kashy, D., A. (2000). The analysis of data from dyads and groups. In H. T. Reis & C. M. Judd (Eds.), *Handbook of Research Methods in Social and Personality Psychology*. Cambridge: Cambridge University Press.

Kirchner, T., R., & Sayette, M., A. (2003). Effects of alcohol on controlled and automatic memory processes. *Experimental and Clinical Psychopharmacology, 11*(2), 167-175.

Koob, G., F., & Bloom, F., E. (1988). Cellular and molecular mechanisms of drug dependence. *Science, 242*, 715-723.

Kushner, M., G., Massie, E. D., Gaskel, S., Mackenzie, T., Fiszdon, J., & Anderson, N. (1997). Alcohol effects on the facial expressions of anxiety patients undergoing panic provocation. *Addictive Behaviors, 22*(2), 275-280.

Lang, A., R., Patrick, C., J., & Stritzke, W., G., K. (1999). Alcohol and emotional response: A multidimensional-multilevel analysis. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 328-371). New York: Guilford Press.

Leary, M., R., Knight, P., D., & Johnson, K., A. (1987). Social anxiety and dyadic conversation: A verbal response analysis. *Journal of Social and Clinical Psychology, 5*, 34-50.

Leary, M., R., & Kowalski, R., M. (1995). *Social Anxiety*. New York: Guilford Press.

Levenson, R., W. (1987). Alcohol affect and physiology: Positive effects in the early stages of drinking. In E. Gottheil, K. Druley, S. Pasko & S. Weintein (Eds.), *Stress and Addiction* (pp. 173-196). New York: Bruner/Mazel.

Levine, J., M., & Moreland, R., L. (1998). Small Groups. In D. T. Gilbert, S. T. Fiske & G. Lindzey (Eds.), *The handbook of social psychology* (4th ed., Vol. 2, pp. 415-469). Boston: McGraw-Hill.

Levine, J., M., Resnick, L., B., & Higgins, E., T. (1993). Social foundations of cognition. *Annual Review of Psychology, 44*, 585-612.

Lewin, K., Lippett, R., & White, R. (1939). Patterns of aggressive behavior in experimentally created "social climates". *Journal of Social Psychology, 10*, 271-299.

Lindman, R. (1982). Social and solitary drinking: Effects on consumption and mood in male social drinkers. *Physiology and Behavior, 28*, 1093-1095.

Lindman, R., Jarvinen, P., & Vidjeskog, J. (1987). Verbal interactions of aggressively and nonaggressively predisposed males in a drinking situation. *Aggressive Behavior, 13*, 187-196.

Littell, R., C., Stroup, W., W. , & Freund, R., J. (2002). *SAS for linear models* (4th ed.). Cary, N.C.: SAS Institute Inc.

Lukas, S., & Mendelson, J. (1988). Electroencephalographic activity and plasma ACTH during ethanol-induced euphoria. *Biological Psychiatry, 23*, 141-148.

MacAndrew, C., & Edgerton, R., B. (1969). *Drunken comportment: A social explanation*. Oxford, UK: Aldine.

MacDonald, T., K., Zanna, M., & Fong, G., T. (1995). Decision making in altered states: effects of alcohol on attitudes toward drinking and driving. *Journal of Personality and Social Psychology, 68*(6), 973-985.

MacDonald, T., K., Zanna, M., & Fong, G., T. (1996). Why common sense goes out the window: Effects of alcohol on intentions to use condoms. *Personality and Social Psychology Bulletin, 22*, 763-775.

Mackinnon, A., Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A., & Rodgers, B. (1999). A short form of the Positive and Negative Affect Schedule: Evaluation and factorial validity and invariance across demographic variables in a community sample. *Personality and Individual Differences, 27*, 405-416.

Maisto, S., A., Carey, K., B. , & Bradizza, C., M. (1999). Social learning theory. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 106-163). New York: Guilford Press.

Marlatt, G. A. (1987). Alcohol, the magic elixir: Stress, expectancy, and the transformation of emotional states. In E. L. Gottheil (Ed.), *Stress and addiction* (pp. 302-322). New York: Brunner/Mazel Publishers.

Marlatt, G. A., Baer, J., S., Donovan, D., M., & Kivlahan, D., R. (1988). Addictive behaivors: Etiology and treatment. *Annual Review of Psychology, 39*, 223-252.

Marlatt, G. A., & Gordon, J. R. (Eds.). (1985). *Relapse prevention : maintenance strategies in the treatment of addictive behaviors*. New York: Guilford Press.

Martin, C., Earleywine, M., Musty, R., Perrine, M., & Swift, R. (1993). Development and validation of the biphasic alcohol effects scale. *Alcoholism: Clinical and Experimental Research, 17*, 140-146.

Martin, C., & Sayette, M., A. (1993). Experimental design in alcohol administration research: Limitations and alternatives in the manipulation of dosage-set. *Journal of Studies on Alcohol, 54*, 750-761.

Mohr, C., Armeli, S., Tennen, H., Carney, M., A., Affleck, G., & Hromi, A. (2001). Daily interpersonal experiences, context, and alcohol consumption: Crying in your beer and toasting good times. *Journal of Personality and Social Psychology, 80*, 489-500.

Monti, P., M., Abrams, D., B., Kadden, R., M., & Cooney, N., L. (1988). *Treating Alcohol Dependence: A Coping Skills Traning Guide*. New York: Guilford Press.

Moreland, R., L. (1987). The formation of small groups. In C. Hendrick (Ed.), *Review of Personality and Social Psychology* (Vol. 8, pp. 80-110). Newbury Park, CA: Sage.

Moreland, R., L., & Beach, S., R. (1992). Exposure effects in the classroom: The development of affinity among students. *Journal of Experimental Social Psychology, 28*, 255-276.

NIAAA (2000). *Special Report to the US Congress on Alcohol and Health* (Vol. NIH Publication No. 00-1583): USDHHS.

Nisbett, R., E. , & Wilson, T., D. (1977). Telling more than we know: Verbal reports on mental processes. *Psychological Review, 84*, 231-259.

Noldus Information Technology (2002). The Observer: Professional System for Collection, Analysis, and Presentation of Observational Data (Version 4.1). Wageningen, The Netherlands.

Perkins, H., Wesley. (2002). Social norms and the prevention of alcohol misuse in collegiate contexts. *Journal of Studies on Alcohol, Supplement No. 14*, 164-172.

Pliner, P., & Cappell, H. (1974). Modification of affective consequences of alcohol: A comparison of social and solitary drinking. *Journal of Abnormal Psychology, 83*(4), 418-425.

Prentice, D., A., & Miller, D., T. (1993). Pluralistic ignorance and alcohol use on campus: some consequences of misperceiving the social norm. *Journal of Personality and Social Psychology, 64*, 243-256.

Read, J., P., Kahler, C., W., & Stevenson, J., F. (2001). Bridging the gap between alcoholism treatment research and practice: Identifying what works and why. *Professional Psychology: Research and Practice, 32*(3), 227-238.

Rohrbaugh, M., Shoham, V., Spungen, C., & Steinglass, P. (1995). Family systems therapy in practice: A systemic couples therapy for problem drinking. In B. Bongar & L. Beutler, E. (Eds.), *Comprehensive textbook of psychotherapy: Theory and Practice*. New York: Oxford University Press.

Rohrberg, R., G., & Sousa-Poza, J., F. (1976). Alcohol, field dependence, and dyadic self-disclosure. *Psychological Reports, 39*, 1151-1161.

Rohsenow, D., & Marlatt, G. A. (1981). The balanced placebo design: Methodological considerations. *Addictive Behaviors, 6*, 107-122.

Rosenberg, E., & Ekman, P. (1994). Coherence between expressive and experientail systems in emotion. *Cognition and Emotion, 8*(3), 201-229.

Sackett, G., P. (1979). The lag sequential analysis of contingency and cyclicity in behavioral interaction research. In J. Osofsky (Ed.), *Handbook of Infant Development* (pp. 623-649). New York: Wiley.

Samson, H., H., & Fromme, K. (1984). Social drinking in a simulated tavern: An experimental analysis. *Drug and Alcohol Dependence, 14*, 141-163.

Sayette, M., A. (1993). An appraisal-disruption model of alcohol's effects on stress responses in social drinkers. *Psychological Bulletin, 114*, 459-476.

Sayette, M., A. (1999). Cognitive theory and research. In K. E. Leonard & H. T. Blane (Eds.), *Psychological theories of drinking and alcoholism* (pp. 247-291). New York: Guilford Press.

Sayette, M., A., Cohn, J., F., Wertz, J., M., Perrott, M., A., & Parrott, D., J. (2001). A psychometric evaluation of the facial action coding system for assessing spontaneous expression. *Journal of Nonverbal Behavior, 25*(3), 167-185.

Sayette, M., A., Martin, C., Perrott, M., A., Wertz, J., M., & Hufford, M., R. (2001). A test of the appraisal-disruption model of alcohol on stress. *Journal of Studies on Alcohol, 62*, 247-256.

Sayette, M., A., & Wilson, G.T. (1991). Intoxication and exposure to stress: The effects of temporal patterning. *Journal of Abnormal Psychology, 100*, 56-62.

Scheier, M., F., & Carver, C., S. (1985). The self-consciousness scale: A revised version for use with general populations. *Journal of Applied Social Psychology, 37*, 1742-1757.

Schmidt, K., L., & Cohn, J., F. (2001). Human facial expressions as adaptations: Evolutionary questions in facial expression research. *Yearbook of Physical Anthropology, 44*, 3-24.

Schuckit, M., A., & Smith, T., L. (2001). The clinical course of alcohol dependence associated with a low level of response to alcohol. *Addiction, 96*(6), 903-910.

Schulenberg, J., E., & Maggs, J., L. (2002). A developmental perspective on alcohol use and heavy drinking during adolescence and the transition into young adulthood. *Journal of Studies on Alcohol, Supplement No. 14*, 54-70.

Sher, K., J. (1985). Subjective effects of alcohol: The influence of setting and individual differences in alcohol expectancies. *Journal of Studies on Alcohol, 46*(2), 137-146.

Sher, K., J. (1987). Stress Response Dampening. In H. T. Blane & K. Leonard (Eds.), *Psychological Theories of Drinking and Alcoholism*. New York: Guilford Press.

Sherif, M. (1936). *The psychology of social norms*. New York: Harper & Row.

Smith, G., T., Goldman, M., S., Greenbaum, P., E., & Christiansen, B., A. (1995). Expectancy for social facilitation from drinking: The divergent paths of high-expectancy and low-expectancy adolescents. *Journal of Abnormal Psychology, 104*(1), 32-40.

Smith, R., C., Parker, E., S., & Noble, E., P. (1975a). Alcohol and affect in dyadic social interaction. *Psychosomatic Medicine, 37*(1), 25-40.

Smith, R., C., Parker, E., S., & Noble, E., P. (1975b). Alcohol's effect on some formal aspects of verbal social communication. *Archives of General Psychiatry, 32*, 1394-1398.

Snyder, M. (1987). *Public Appearances/Private Realities: The Psychology of Self-Monitoring*. San Francisco: Freeman.

Steele, C., M., & Josephs, R., A. (1988). Drinking your troubles away: II. An attention-allocation model of alcohol's effects of psychological stress. *Journal of Abnormal Psychology, 97*, 197-205.

Steele, C., M., & Josephs, R., A. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist, 45*, 921-933.

Stokes, M., E., Davis, C., S., & Koch, G., G. (2000). *Categorical Data Analysis Using the SAS System*. Cary, NC: SAS Institute Inc.

Stone, A., A., Turkkan, J., S., Bachrach, C., A., Jobe, J., B., Kurtzman, H., S., & Cain, V., S. (Eds.). (2000). *The Science of Self-Repot: Implications for Research and Practice*. Mahwah, N.J.: Lawrence Erlbaum Associates.

Stritzke, W., G., K., Lang, A., R., & Patrick, C., J. (1996). Beyond stress and arousal: A reconceptualization of alcohol-emotion relations with reference to psychophysiological methods. *Psychological Bulletin, 120*, 376-395.

Sullivan, D., G., & Masters, R., D. (1991). Facial displays and political leadership: Some experimental findings. In G. Schubert & R. Masters, G. (Eds.), *Primate Politics* (pp. 188-206). Carbondale: Southern Illinois University Press.

Surakka, V., & Hietanen, J., K. (1998). Facial and emotional reactions to Duchenne and non-Duchenne smiles. *International Journal of Psychophysiology, 29*, 23-33.

Tajfel, H., & Turner, J., C. (1986). The social identity theory of intergroup behavior. In S. Worchel & W. Austin, G. (Eds.), *Psychology of Intergroup Relations* (pp. 7-24). Chicago: Nelson.

Tennen, H., Affleck, G., & Armeli, S. (2003). Daily processes in health and illness. In J. Suls & K. Wallston, A. (Eds.), *Social Psychological Foundations of Health and Illness* (pp. 495-529). Oxford: Blackwell.

Thompson, L., & Fine, G., A. (1999). Socially shared cognition, affect, and behavior: A review and integration. *Personality and Social Psychology Review, 3*, 278-302.

Thompson, R. (1998). Early socio-personality development. In N. Eisenberg (Ed.), *Handbook of Child Psychology* (5th ed., Vol. 3, pp. 25-104). New York: Wiley.

Tickle-Degnen, L., & Rosenthal, R. (1987). Group rapport and nonverbal behavior. In C. Hendrick (Ed.), *Review of Personality and Social Psychology: Group Process and Intergroup Relations* (Vol. 9, pp. 113-136). Newbury Park, CA: Sage.

Tucker, J., A., Vuchinich, R., A., & Pukish, M., M. (1995). Molar environmental contexts surrounding recovery from alcohol problems by treated and untreated problem drinkers. *Experimental and Clinical Psychopharmacology, 3*(2), 195-204.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology, 54*, 1063-1070.

Weingart, L., R. (1997). How did they do that? The ways and means of studying group process. In B. Staw, M. & L. Cummings, L. (Eds.), *Research in Organizational Behavior* (Vol. 19, pp. 189-239). Greenwich, CT: JAI Press.

Willsie, D., A., & Riemer, J., W. (1980). The campus bar as a "bastard institution". *Mid-American Review of Sociology, 5*(2), 61-89.

Yankofsky, L., Wilson, G., Terrance, Adler, J., L., Hay, W., M., & Vrana, S. (1986). The effect of alcohol on self-evaluation and perception of negative interpersonal feedback. *Journal of Studies on Alcohol, 47*, 26-33.